UL PureSafety

OSHA 30 Construction Industry
Complete Job Aid

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This job aid provides reminders about information covered in UL Solutions online training courses. Always abide by local rules, regulations, equipment instructions, and your company's health and safety policies and procedures.

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Introduction to OSHA

The Occupational Safety and Health Act of 1970 was passed by Congress "to assure so far as possible every working man and woman in the nation safe and healthful working conditions and to preserve our human resources."

The Occupational Safety and Health Administration (OSHA) is a division of the United States Department of Labor.

Since its creation in 1971, OSHA has had a big impact on worker health and safety.

Employer Responsibilities

The mission of OSHA is to save lives, prevent injuries and protect the health of America's workers. Employers must:

- Meet their responsibility to provide a workplace free from recognized hazards
- Keep workers informed about OSHA and safety and health matters with which they are involved
- Comply, in a responsible manner, with standards, rules and regulations issued under the OSH Act
- Be familiar with mandatory OSHA standards
- Make copies of standards available to employees for review upon request
- Evaluate workplace conditions
- Minimize or eliminate potential hazards
- Provide safe, properly maintained tools and equipment and ensure that employees use them
- Warn employees of potential hazards
- Establish or update operating procedures and communicate them to employees
- Provide medical examinations when required
- Provide training required by OSHA standards
- Report a fatality, hospitalization, amputation or loss of an eye
- Keep OSHA-required records of work-related injuries and illnesses and post them appropriately
- Avoid discriminating against employees who properly exercise their rights under the OSH Act
- Provide access to employee medical records and exposure records to workers and others as required by law
- Determine if personal protective equipment (PPE) should be used to protect workers
- Pay for most required PPE

Employer Rights

- Seek free advice and on-site consultation from OSHA
- Be involved in job safety and health through industry associations
- Take an active role in developing safety and health programs
- Be assured of the confidentiality of any trade secrets

- Submit a written request to the National Institute for Occupational Safety and Health (NIOSH) for information on whether any substance in a workplace has potentially toxic effects in the concentrations being used
- Submit information or comments to OSHA on the issuance, modification or revocation of OSHA standards and request a public hearing

Employee Responsibilities

- Read the OSHA "It's the law!" poster (OSHA 3165) at the jobsite
- Comply with all applicable OSHA standards
- Follow all employer safety and health rules and regulations, and wear or use prescribed protective equipment while engaged in work
- Report hazardous conditions to their supervisor
- Report any job-related injury or illness to their employer, and seek treatment promptly
- Cooperate with the OSHA compliance officer conducting an inspection
- Exercise their rights under the OSH Act in a responsible manner

Employee Rights

- Receive adequate training and information
- Request information from their employer on safety and health hazards, precautions and emergency procedures
- Review copies of appropriate OSHA standards, rules, regulations and requirements that the employer should have available at the workplace
- Request that OSHA investigate if employees believe hazardous conditions or violations of standards exist in their workplace
- Observe any monitoring or measuring of hazardous materials and see any related monitoring or medical records
- Object to the abatement period set in a citation issued to their employer
- Participate in hearings conducted by the Occupational Safety and Health Review Commission
- Submit information or comments to OSHA on the issuance, modification or revocation of OSHA standards and request a public hearing
- Seek safety and health on the job without fear of punishment
- Refuse to do a job if they believe in good faith that they are exposed to imminent danger

OSHA's Recordkeeping Requirements

As set out in the OSH Act, OSHA established an effective, centralized, nationwide system for monitoring occupational safety and health problems – a vital requirement for gauging problems and solving them.

Keeping records allows OSHA to compile survey material, helps identify high-hazard industries, and informs employees about their employers' workplace safety record. These records also help employers identify potential sources of injuries and illnesses at their worksites – and hopefully then correct or mitigate them.

Inspections

Inspections may be conducted by OSHA compliance safety and health officers. A typical on-site inspection includes the presentation of inspector credentials, an opening conference, an inspection walk-around and a closing conference. **Inspection priorities, in order, are:**

1. **Imminent Danger:** Inspecting a workplace where a danger exists that can be expected to cause death or serious physical harm is the highest priority.
2. **Fatalities/Catastrophes:** Fatalities as well as catastrophes that result in hospitalization, amputation or loss of an eye must be reported by the employer to OSHA.
3. **Complaints/Referrals:** A worker or worker representative can file a complaint about a safety or health hazard in the workplace.
4. **Programmed Inspections:** These inspections cover industries and employers with high injury and illness rates, specific hazards or other exposures.
5. **Follow-up Inspections:** OSHA also conducts follow-up and monitoring inspections. These inspections are made as needed and take priority over programmed inspections.

Citations and Penalties

Citations inform the employer and employees of the regulations and standards allegedly violated and of the proposed time for abatement. The employer must post a copy of each citation at or near the place where the violation occurred, for 3 days or until the violation is corrected, whichever is longer.

Under the OSH Act, OSHA may cite the following violations and propose the following penalties. Note that the threshold for penalties changes annually. You can find more information on the OSHA website.

- **Other-than-Serious:** A violation that has a direct relationship to job safety and health, but probably would not cause death or serious physical harm. OSHA may propose penalties for each other-than-serious violation
- **Serious:** A violation where there is substantial probability that death or serious physical harm could result and that the employer knew, or should have known, of the hazard. OSHA may propose mandatory penalties for each serious violation
- **Willful:** A violation that the employer intentionally and knowingly commits, or a violation that the employer commits with plain indifference to the law. OSHA may propose large penalties for each willful violation, and there is a minimum penalty for each violation

Other penalties are **Repeated** and **Failure-to-Abate**. If an employer chooses to appeal a decision, it must be done formally in writing within 15 working days of receiving the citation.

General Duty Clause

What if there is no specific standard forbidding a particular activity, but that activity can easily be identified as being dangerous and potentially harmful to a worker? Can the employer be cited? The answer is YES!

The company or employer can be cited under the "General Duty Clause" found in the OSH Act.

Resources

There are many resources available to you if you want to find out more information about a safety or health issue in your workplace.

These include:

- Your employer, supervisor and co-workers
- Safety Data Sheets (SDSs)
- Labels and warning signs
- Employee orientation manuals and other training materials
- Written procedures
- OSHA's hotline at **1-800-321-OSHA (6742)**
- The OSHA website: **http://www.osha.gov**
- Your local area or regional OSHA office
- Compliance Assistance Specialist training sessions/materials
- Health Hazard Evaluations (HHEs) conducted by the National Institute for Occupational Safety and Health (NIOSH)
- OSHA Training Institute Education Centers (OTIEC) and other university occupational and environmental health programs
- Doctors, nurses and other healthcare providers
- Public libraries

OSHA Inspections for Construction and Multi-Employer Worksites

Employer Categories
OSHA uses four categories of employers to determine who to cite for hazards and exposures:

- **Creating Employers** creates or cause a hazardous condition that violates an OSHA Standard and exposes any employee to it
- **Exposing Employers** are those whose own employees are exposed to a hazard
- **Controlling Employers** have general supervisory authority over the worksite and must exercise reasonable care to prevent and detect violations for ALL jobsite employees, regardless of company affiliation
- **Correcting Employers** are responsible for using reasonable care and correcting hazards

A single employer may fall into multiple OSHA employer categories.

Citable Entities
When OSHA identifies an issue on a multi-employer worksite, they:

1. Identify the categories that apply to the offending employer.
2. Determine who met or did not meet relevant safety obligations.

Regardless of whom is citable, EVERYONE is responsible for worksite safety.

More than one employer on a multi-employer worksite can be cited for the same violation.

Best Practices
Employers should work together to prevent, detect and resolve safety issues. EVERYONE should report safety issues. Employers must communicate to resolve issues and take steps to protect people. At multi-employer worksites:

- Ensure contractors and subcontractors have proper safety policies
- Check for history of incidents/violations
- Follow the site-specific safety plan
- Collaborate to ensure everyone understands mutual responsibilities and how to avoid hazards
- Prepare for OSHA inspections

OSHA Inspection Process
At multi-employer worksites, employers have rights and steps at each phase of the process.

1. **Arrival**. Alert all employers at the worksite when an inspector arrives.
2. **Opening Conference**. All employers should attend the opening conference. At the conference, ask questions and establish ground rules.
3. **Tour**. All employers have a right to have a representative present during the OSHA inspection tour. Employers may correct problems during the tour. Inspectors may ask employers for permission to expand the inspection, based on findings.
4. **Closing Conference**. At the closing conference, all employers should:
    - Review inspector observations
    - Discuss violations
    - Learn appeal rights
    - Ask questions

Applying Electrical Standards

Consequences of Not Following Electrical Standards

For employees, failing to follow Occupational Safety and Health Administration (OSHA) regulations and consensus standards can result in death, injuries or loss of employment.

For employers, failing to follow OSHA regulations and consensus standards can result in:

- Civil penalties (fines)
- Criminal penalties (jail time)
- Increased costs (lawsuits, insurance premiums, etc.)
- Lost business (negative publicity, damaged reputation/brand integrity)
- Property damage

OSHA: 29 CFR 1910 (General Industry) and 29 CFR 1926 (Construction)

Workers should NOT work on energized equipment **unless**:

- De-energizing introduces additional or increased hazards (example: hospital life support)
- Removing power is not feasible due to equipment design or operational limitations (example: power is needed to troubleshoot equipment)

Where an electrical hazard exists, such as when electrical equipment must remain energized while servicing and maintenance is performed, the work must be performed by a **qualified person**. A qualified person is someone who has the skills, training or credentials needed to work safely around electrical hazards. A person can be qualified for specific equipment and methods, but still be unqualified for others.

Consensus Standards

Consensus standards are guidelines that nationally recognized, standards-producing organizations produce and distribute. Consensus standards are updated more frequently than OSHA standards and provide additional information.

Consensus standards for electrical work include:

- National Fire Protection Association (NFPA)
    - NFPA 70, National Electrical Code (NEC)
    - *NFPA 70E*®
- National Electrical Safety Code (NESC)
- American National Standards Institute (ANSI)
- American Society for Testing and Materials (ASTM)
    - ASTM F1506 – fabric flame-resistance
    - ASTM F2178 – eye and face protection

NFPA 70E® Training Requirements

Unqualified Worker Training

Employers must train unqualified workers about:

- Electrical dangers
- Approach boundaries

- Lockout/tagout (LOTO) procedures

Qualified Worker Training

Employers must train qualified workers about **safe work practices**, such as:

- Verifying the energy condition
- De-energizing equipment that has lockout/tagout applied
- Releasing stored electrical energy
- Using temporary protective grounding equipment
- Releasing or blocking stored mechanical energy
- Responding to emergencies (including contact release and first aid)
- Using electrical equipment, such as testing instruments and GFCI protection
- Verifying proper installation, maintenance, use and safeguards
- Getting energized electrical work permits

Work will be supervised during the training and qualification process, and a hands-on demonstration of skills is essential to the qualification process. Training is needed every 3 years and sooner if everyday supervision or annual skills inspections determine deficiencies. Training is also needed after changes to equipment, procedures and job roles. Employees are expected to review infrequently performed and unfamiliar tasks.

Employers must train qualified workers about **safety-related maintenance and operating requirements**:

- Qualified persons
- Single-line diagrams
- General requirements
- Overcurrent protection
- Working space
- Grounding and bonding
- Guarding energized conductors
- Safety equipment
- Clear spaces
- Identification of components
- Warning signs
- Identification of circuits
- Single/multiple conductors and cables
- Flexible cords and cables
- Overhead line clearances
- Substations
- Premises wiring
- Controller equipment
- Fuses and circuit breakers
- Rotating equipment
- Hazardous locations
- Batteries and battery rooms
- Portable electrical tools and equipment
- Personal safety/protective equipment

Employers must train qualified workers about **safety requirements for special equipment**, including safety-related work practices for:

- Electrolytic cells and use of lasers
- Power electronic equipment
- Research and development laboratories
- Batteries and battery rooms

If a qualified person performs work within the **limited approach boundary** of exposed energized parts operating at 50 volts or more, they must be trained on:

- Distinguishing exposed energized parts from other parts of electrical equipment
- Determining nominal voltage of exposed energized parts
- Approach-boundary distances and corresponding voltages of exposure

- Decision-making processes to determine the degree and extent of a hazard and the PPE and job planning necessary to perform a task safely

Using *NFPA 70E*® Tables

NFPA 70E® tables contain vital information about approach boundaries, hazard categories and PPE. Always use the most current edition of the *NPFA 70E*® when working on energized electrical equipment. You can purchase the latest standards at www.nfpa.org.

Using Electrical Safety Programs

NFPA 70E® requires employers to develop and implement an electrical safety program that:

- Directs activities appropriate for the voltage, energy level and circuit conditions that employees may encounter
- Defines safety practices required by the employer and any applicable standards

Purpose of Electrical Safety Programs

Electrical safety programs are designed to help people make safe decisions when they are working around electricity. The goals of the program are to improve:

- **Awareness** about electrical hazards
- **Self-discipline** about using safety principles/practices

Capacitors

- Discharge capacitors following steps listed in energy control procedures
    - This commonly involves bleeding down stored energy using an insulated tool with properly sized resistor and grounding cable
    - Always assume that capacitors are charged until electrical metering proves otherwise
- Capacitors should be short circuited with a drain wire and grounded, if appropriate, to the case when not in use

Elements of an Electrical Safety Program

- Procedures
    - De-energize equipment before starting service/maintenance work (zero-energy state)
    - Follow lockout/tagout (LOTO) steps
- Controls
    - Consider every electrical conductor/circuit energized until proven otherwise
    - Avoid bare-hand contact with energized conductors/circuits
    - Use procedures to identify hazards and eliminate or control them
    - Clearly identify equipment controls
    - Remember that accurate and reliable electrical drawings are essential
- Hazard/Risk Evaluation
    - Complete electrical shock and arc-flash hazard analyses
- Work Permits
    - Remember that work permits are required for work on equipment that must remain energized and when workers are potentially exposed to live parts, or near enough to expose them to any hazard they present
    - Permits must include justification for working on live systems, descriptions of electrical shock and arc flash risk, precautions, and measures taken to exclude unqualified personnel
    - Know that permits are only valid when conditions remain the same
- Testing Equipment
    - Inspect testing equipment regularly
    - Use high-quality voltage meters

    - Use hot sticks and grounding cables, as needed
- Inspection
    - Inspect newly installed or modified equipment and systems for compliance with installation codes and standards
    - Following installation, equipment must be maintained according to manufacturer recommendations

Arc-flash Hazard Analysis

- Use *NFPA 70E*® tables to identify hazard classes and personal protective equipment (PPE)
- Perform a detailed analysis to identify approach boundaries
- Identify and label equipment
- Use signs, barricades and/or attendants

Approach Boundaries

Arc-flash Boundary

- Establishes how close a person without PPE could get to exposed energized conductors/parts and only receive incident energy equal to 1.2 calories per square centimeter from an arc-flash (that's the amount of energy associated with second-degree burns on exposed bare skin
- People must not cross the arc-flash boundary unless they are wearing the appropriate PPE and are under close supervision by a qualified person
- Only qualified people wearing appropriate PPE may cross the arc-flash boundary when energized work is being performed

Limited Approach Boundary

- Indicates where to place barriers to protect unqualified people from electrical shock hazards
- Only qualified people and escorted unqualified people are allowed

Restricted Approach Boundary

- Only qualified people wearing appropriate PPE are allowed as electrical arcing and electrical shock from inadvertent movement become a concern at this distance
- Qualified people must have a work plan and permit (if required)

Personal Protective Equipment (PPE) for Electrical Hazards

AVOID synthetic cloth that can melt on skin and cause extensive burns, such as:

- Acetate
- Polyester
- Nylon
- Polypropylene
- Spandex

CHOOSE natural fibers, such as:

- Cotton
- Wool
- Rayon

- Silk
- Untreated blends

Electrical hazard PPE must be arc-rated. It includes:

- Multi-layered flash suit jacket/pants
- Hard hat
- Arc-rated hard hat liner (if needed)
- Safety glasses, goggles, an arc-rated face shield, and an arc-rated balaclava or a flash suit hood
- Canal inserts
- Voltage-rated gloves and rubber sleeves
- Leather gloves (worn over rubber)
- Leather work shoes rated EH (for Electrical Hazards)
- Insulated blankets/mats
- Voltage-rated, insulated tools

Personal Protective Equipment (PPE): Electrical Protection

IMPORTANT: ONLY qualified people should work with or around uncontrolled electricity. Taking this course DOES NOT qualify anyone to work on or near the dangerous voltages of exposed energized electrical conductors. Only electrical workers who have received *extensive specialized* electrical safety training and *specific electrical qualification* from their employer may follow the electrical precautions discussed in this course.

Hazards
The more current a person is exposed to, the more serious the injuries. Some injuries can cause death.

- 1 - 3 Milliamperes: Perception threshold for most people
- 3 - 9 Milliamperes: Painful sensations
- 9 - 25 Milliamperes: Muscular contractions (can't let go)
- 25 - 60 Milliamperes: Lungs stop, can't breathe (may be fatal)
- 50+ Milliamperes: Irregular heartbeat (likely fatal)
- 4 Amps: Heart stops (CPR may restart)
- 5 Amps: Severe burns (fatal shock to vital organs)

Use electrical protection when working with **sources of electricity**, such as utility lines, electrical systems, circuits or equipment. Electrical protection is insulated (not conductive) and electrically rated to limit or halt the electrical current that reaches your body. We use electrical protection to **supplement** other precautions, or controls, such as de-energizing equipment, verifying de-energization, and locking and tagging electrical equipment during maintenance. Electrical protection is vital because it is the last barrier between you and electricity when other controls fail.

Protection that is specifically designed for electrical hazards must have **labels** and **markings** that indicate its protective qualities and limitations. Electrical protection should meet applicable **regulatory standards** specific to your location, such as NFPA 70E in the United States. Hazard assessments should specify what controls you must use for electrical tasks, including the types and ratings of electrical protection.

Electrical PPE is worn by workers to protect themselves from electrical hazards. It may include:

- Hard hats and helmets that conduct electricity away from the wearer
- Balaclavas or head socks that help protect the head during arc-flashes
- Hearing protection for loud arc-flash noise
- Safety glasses and goggles that do not conduct electricity
- Face shields to help protect the face from molten metals and arcing energy
- Clothing, suits and undergarments made of materials that will not ignite, melt or adhere to skin
- Gloves and sleeves to resist current to the hands and arms
- Shoes with non-metallic safety toe caps

Electrical PPE may be worn alone or with other PPE, depending on the hazard assessment. **Insulating protective equipment (IPE)** includes barriers that the worker uses to prevent contact with energized conductors. It may include barriers to prevent contact with energized conductors, insulating blankets, insulated switchboard mats, and tools and tool covers that the worker uses but does not wear.

Use and Care

Electrical protection should **supplement** other controls. Your employer should have a written program that explains how to manage electrical protection effectively, including when and how to use, care for, inspect and maintain electrical PPE. You should receive training about the specific electrical PPE that is required for your job.

Defective or damaged electrical protection can fail and cause voltage breakthroughs that may injure the wearer. **Inspect**, test, clean and care for electrical protection per the manufacturer, relevant regulatory agencies and company guidelines. This includes inspecting the protection before and after each use. For example, in the United States, NFPA 70E requires that a qualified laboratory test electrical gloves every 6 months as well as when there are concerns about the insulating value, after repairs and after anyone uses the gloves without leather protectors.

Electrical protection must be free of **defects** such as holes, tears, punctures, cuts and embedded objects. It must also be free of signs of wear including cracks, discoloration and texture changes such as swelling, softening, hardening, stickiness or stretching. Electrical gloves, sleeves and blankets must be seamless. Make sure electrical protection is dry before using it.

Follow the manufacturer's instructions to perform **air or water testing** on electrical gloves to check for tiny, invisible holes that can compromise their ability to protect the wearer from electrical current.

1. Fill gloves with air or submerge them in clean water.
2. Look, listen and feel for leakage, which may produce a hissing sound in air or bubbles in water.
3. Repeat the test with the gloves inside out.

Gloves must be completely dry before you use them after water testing.

If you find any **defects or damage** during electrical PPE **inspection**, follow your company's procedures to report the issue, remove the electrical protection from service, and replace the electrical protection. It's best to destroy defective PPE that is specifically designed for electrical hazards so that no one else will use it for any task.

Remove jewelry and other metal such belts, buttons and zippers that may be exposed before donning electrical PPE. Metal items may conduct electricity, cause burns if they are exposed to an arc-flash, and cut or tear protective material. Wear cotton or natural fiber garments because some synthetics can melt to the person in an arc-blast event even when worn under proper PPE. Any protective clothing should cover the intended area of protection.

Store electrical protection where it is protected from light, temperature extremes, excessive humidity, ozone, and chemicals or substances that could damage it. Do NOT fold electrical gloves. Store them in the separate, dedicated bag provided by the manufacturer.

Electrical Safety for Construction: Cord and Plug Connected Equipment

Using electricity around construction sites is so common that it's easy to forget it can cause everything from minor electrical shocks to electrocutions and explosions. You need to be able to identify electrical hazards and protect yourself from them.

Electrical Hazards
Electrical hazards are conditions that expose workers to a number of dangers. You can remember the types of dangers associated with electricity by remembering the phrase "BE SAFE":
[B] A **BURN** is the most common electrical shock-related injury and is caused by heat from electricity flow, an electric arc or explosion, or overheated electrical equipment.
[E] ELECTROCUTION results when a human is exposed to a lethal amount of electrical energy.
[S] Electrical **SHOCK** results when the body becomes part of the electrical circuit; current enters the body at one point and leaves at another.
[A] An **ARC FLASH** is the sudden release of electrical energy through the air. It gives off intense heat and bright light that can cause burns and can also produce strong pressure waves.
[F] Most electrical distribution **FIRES** result from wiring problems and problems with cords, plugs, receptacles and switches.
[E] An **EXPLOSION** can occur when electricity ignites an explosive mixture of material in the air.

Contact with Energized Sources
Contact with energized sources is likely to result in electrical shock and burns. Electrical burns can be:

- Arc burns
- Thermal contact burns
- Combination of burns

The severity and effects of an electrical shock depend on the:

- Pathway through the body
- Amount of current
- Length of exposure time
- Moisture on the skin at the time

REMEMBER: It takes very little current to do significant damage to your body or even kill you.

Improper Use of Extension and Flexible Cords
Flexible extension cords are often necessary on construction sites but may increase the risk of contact with electrical current if they are not 3-wire type, are not designed for hard-usage or have been modified.

To reduce electrical hazards:

- Properly use and maintain: cords, cord connectors, receptacles, and cord- and plug-connected equipment

- Connect cords to devices and fittings in ways that prevent tension at joints and terminal screws
- Be aware that cords may be damaged by door or window edges, staples and fastenings, abrasion from adjacent materials, or simply by aging
    - Properly route, secure and guard cords to prevent this damage and inspect for it prior to use
- Make sure electrical conductors are not exposed
- Keep cord connectors dry

Keep cords and equipment traffic separated! Reroute cords or cover cords with protectors. Heavy weight on cords can cause internal damages you cannot see!

General Safety Precautions

To protect yourself from electrical hazards, you can:

- Use ground-fault circuit interrupters (GFCIs)
- Inspect portable tools and extension cords
- Use power tools and equipment as designed

Use Ground-Fault Circuit Interrupters (GFCIs)

A ground-fault circuit interrupter (GFCI) is designed to protect people from severe electrical shocks by limiting the duration of an electrical shock. It detects ground faults and interrupts the flow of electric current. There are three types of GFCIs:

- Receptacle
- Temporary/Portable
- Circuit Breaker

Tool Safety Tips

- Inspect extension cords and tools prior to using them
- Flexible cords used with temporary and portable lights must be designed for hard use and should be marked with a usage-type designation size and number of conductors
- Never carry a tool by the cord
- Never yank a cord to disconnect a tool
- Keep cords away from heat, oil and sharp edges
- Disconnect tools when not in use and when changing accessories
- Do not hold fingers on the switch button while carrying a plugged-in tool
- Wear gloves and appropriate footwear
- Store tools in a dry place
- Do not use tools in wet/damp environments
- Keep working areas well-lit
- Ensure that cords do not cause a tripping hazard
- Remove damaged tools from use
- Use double-insulated tools

Even when a power system is properly grounded, electrical equipment can be hazardous because of extreme conditions, rough treatment and misuse.

Employer Requirements

To protect workers from electrical hazards, employers:

- Isolate electrical parts
- Supply ground-fault circuit interrupters (GFCIs)
- Establish and implement an assured equipment grounding conductor program (AEGCP)
- Ensure power tools are maintained in a safe condition
- Ensure proper guarding
- Provide training
- Ensure proper use of flexible cords

Many companies implement both GFCI and AEGCP protections even when regulations would have allowed just one these approaches. Learn what's required where you work.

Many companies use a written assured equipment grounding conductor program (AEGCP) to make sure cords and equipment are checked and the grounding conductor is kept in good condition.

One best practice is to apply a specific color of tape to a cord after confirming it is grounded. This way, workers can visually confirm when the cord was inspected. Remember that pre-use inspections are still a good idea, even if the tape indicates a recent inspection.

The AEGCP will:

- Include specific grounding procedures
- Explain how to complete required equipment inspections and tests

Electrical Safety for Construction: Power Lines and Lockout/Tagout

Using electricity around construction sites is so common that it's easy to forget it can cause everything from minor electric shocks to electrocutions and explosions. To stay safe, you need to be able to identify electrical hazards and protect yourself from them.

Electrical Hazards
Electrical hazards are conditions that expose workers to a number of dangers. You can remember the types of dangers associated with electricity by remembering the phrase "BE SAFE."

[B] A **BURN** is the most common electrical shock-related injury and is caused by heat from electricity flow, an electric arc or explosion, or overheated electrical equipment.
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Electrical hazards discussed in this course include contact with overhead power lines and contact with energized sources.

Contact with Power Lines
Overhead and buried power lines carry extremely high voltage. Risks associated with them include electrocution (death), burns and falls from elevations. Use caution anytime you are working with cranes, ladders or other equipment under or near power lines. Survey for the possibility of embedded electrical cables before cutting or drilling into walls. Survey for the possibility of buried cables before digging. Any covering on overhead power lines is for weather protection and will not protect from electrical shocks and arcing. Death is likely if you contact them.

Hazard Precautions
Contact with Energized Sources
Contact with energized sources is likely to result in electrical shock and burns. Electrical burns can be:

- Arc burns
- Thermal contact burns
- Combination of burns

The severity and effects of an electrical shock depend on the:

- Pathway through the body
- Amount of current
- Length of exposure time
- Moisture on the skin at the time

REMEMBER: It takes very little current to do significant damage to your body or even kill you.

Hazard Precautions

To protect yourself from electrical hazards, you can maintain a safe distance from overhead power lines and follow lockout/tagout procedures.

Before working near overhead power lines, make sure:

- Equipment/activities are located a safe distance from power lines
- The utility company has de-energized and visibly grounded the power lines or installed insulated sleeves on power lines
- Flagged warnings are in place to mark horizontal and vertical power line clearance distances
- Tools and materials are non-conductive

Equipment Around Power Lines

Cranes and Other High-Reaching Equipment

Be sure the utility company has confirmed the voltage and safe working distance from the power lines. Also, if crane work activities come within 20 feet of lines, you will need:

- An observer
- Barricades
- Pre-task plans
- An insulated link
- A boom cage guard
- A proximity device

Learn about specific precautions to follow where you work.

Ladders

Use non-conductive ladders and be sure to retract them before moving.

Material Storage

- Ensure that no materials are stored under power lines
- Use caution tape and signs to block the area under power lines

Excavations

- Locate and identify the markings from the local underground line locator service
- Hand dig within three feet of cable locations
- Be aware that more than one underground cable may be buried in the area of locator markings
- Once a locating device has been used to determine cable positions and routes, excavation may take place, with trial holes dug using suitable hand tools as necessary to confirm this

- Excavate alongside the service rather than directly above it. Final exposure of the service by horizontal digging is recommended, as the force applied to hand tools can be controlled more effectively
- Insulated tools should be used when hand digging near electric cables

Lockout/Tagout

Lockout/tagout is an essential safety procedure that protects workers from electrical injury. It prevents contact with operating equipment parts and prevents the unexpected release of hazardous materials near workers.

The general steps of lockout/tagout are as follows:

1. Check for procedures and identify all sources of energy for the equipment or circuits in question.
2. Disable backup energy sources such as generators and batteries.
3. Identify all shut-offs for each energy source.
4. Notify all personnel that equipment and circuitry must be shut off, locked out, and tagged out.
5. Shut off energy sources and lock switch gear in the OFF position.
6. Deplete stored energy by bleeding, blocking, grounding, etc.
7. Test equipment and circuitry to ensure they are de-energized. A **qualified person** must do this.
8. Apply a lock or tag to alert other workers that an energy source or piece of equipment has been locked or tagged out.
9. Make sure all workers are safe and accounted for before equipment and circuits are unlocked and turned back on.
10. Make sure a qualified person determines when it is safe to re-energize circuits.

Employer Requirements

To protect workers from electrical hazards, employers are required to:

- Ensure overhead power line safety
- Isolate electrical parts
- Enforce lockout/tagout safety-related work practices
- Provide employees with tools, equipment and training to do the job safely

Lockout/Tagout (LOTO) Programs and Procedures

Energy powers industrial machines and systems. Many people may hear the word "energy" and think of electricity. However, many other forms of energy are hazardous. For example, energy may be: electrical, mechanical, hydraulic, pneumatic, radiation, thermal or chemical. See your supervisor or safety professional or review lockout/tagout procedures to learn about forms of hazardous energy where you work.

An **energy-isolating device** physically prevents the transmission or release of energy by blocking or isolating it. Examples include a manually operated electrical circuit breaker, a disconnect switch, a conductor switch, a line valve, a block, a blank flange, or a bolted slip blind. The power button is NOT an energy-isolating device.

Lockout is locking the energy-isolating device so that people CANNOT operate the equipment or restore power until the lockout device is removed. A lockout device holds an energy-isolating device in a safe position. Examples include padlocks and hasps.

Tagout is tagging the equipment to indicate that people MAY NOT operate it or restore power until the tagout device is removed. Tagout is not a physical restraint. Use tagout devices in addition to lockout devices. When lockout is not possible, we must still tag out. Tagout devices must be legible, durable and secure. Attach tagout devices to (or as close as possible to) the energy-isolating device.

Lockout and tagout devices must be durable (able to withstand environment/use), standardized (consistent in color, shape, size, print and format), substantial (able to withstand 50 lbs or 23 kg of force, hard to accidentally remove or miss) and identifiable (easy to recognize and understand).

Energy Control Program
Employers use an **energy control program** to ensure that equipment is de-energized and isolated from its energy sources before people perform service and maintenance. The program includes information that employees need to know so they may safely perform lockout/tagout. Programs are written to meet the needs of the workplace and the types of equipment people will maintain or service.

Energy control programs include:

- **Energy control procedures** including: how to use the procedure; steps to shut down, isolate, block and secure equipment; steps to place, remove and transfer lockout/tagout devices; responsibilities during procedures; and requirements for testing equipment to verify energy control.
- **Inspection requirements**. At least once per year, employers conduct formal inspections of their energy control procedures to make sure they are effective, and that people are using them appropriately. The inspection may include reviewing procedures and responsibilities with employees to ensure their understanding of the energy control program. Inspection documentation include the name of the inspector, the date of the inspection, and the equipment and people included in the inspection. The inspector and

responsible people note any defects, correct those defects and document their corrective actions, per their employer's requirements.
- **Training requirements**. Energy control programs outline training and retraining requirements employees must meet depending on their exposure to equipment, types of energy and hazards. In addition to refresher training, employees receive training when inspections reveal defects and when assignments, equipment or procedures change.

As you are using the energy control program, if you identify a problem, you must stop. Make sure you or a qualified person addresses any issues before you continue working.

Applying Locks and Tags
Please use your employer's specific energy control program and procedures. Only authorized employees apply locks and tags. If you have any questions about your authorization or the energy control program, please ask your supervisor. The authorized employee will:

1. Notify affected employees.
2. Prepare for shutdown.
3. Shut down equipment.
4. Isolate energy.
5. Apply locks and tags.
6. Make stored/residual energy safe.
7. Verify de-energization.

Removing Locks and Tags
Please follow your employer's specific energy control program and procedures when removing lockout/tagout devices. Only the authorized employee who installed the locks and tags can remove locks and tags. In rare cases in which the authorized employee is not available/ reachable, follow the energy control program guidance to identify a designee to remove the locks and tags and inform the original installer.

The authorized employee will:

1. Inspect the work area.
2. Keep people away.
3. Remove lockout/tagout devices.
4. Notify affected people.

Other Considerations for Lockout/Tagout
There are some situations when your energy control program will have unique procedures you must follow.

These may include:

- **Energization required for testing**. Some servicing or maintenance operations may require equipment or components to be energized. In these cases, the energy control program may require the authorized person to clear the area, remove the devices, test the equipment and then, eventually, reapply locks and tags using standard procedures.
- **Outside personnel being on-site**. When outside personnel, such as contractors, are on-site, the employers should inform each other of their respective lockout or tagout procedures. Each employer ensures that their employees understand and comply with all the procedures, restrictions and prohibitions in their energy control programs.
- **Shift changes**. Use the procedures in the energy control program during shift or personnel changes to ensure the continuity of lockout or tagout protection.

- **Group lockout/tagout procedures**. Please consult your employer's energy control program for procedures for group lockout/tagout. These may include identifying a person responsible for group lockout/tagout; describing personal lockout or tagout device and processes; and using a group lockbox or lockout device

Fall Protection

Use fall protection anytime you are working on an unprotected or elevated work surface from which you could fall. Fall protection is required when working 4 to 6 feet above the ground. Ask your manager or supervisor for guidance about using fall protection on your worksite.

Common Fall Hazards
Common fall hazards include:

- Floor holes
- Open-sided floors
- Roof edges
- Skylights
- Ladders
- Mobile elevated work platforms such as scissor lifts and aerial lifts

Mistakes that may cause a fall include:

- Not respecting fall hazards
- Not paying attention
- Equipment/tool failure
- Slips
- Overreaching
- Complacency

Methods of Fall Protection
Use fall protection when:

- Guardrails are removed
- Guardrails/covers are not able to be installed
- You are working hands-free

Primary fall protection includes footing, balance, handholds, stable work surfaces, and positioning equipment.

Secondary fall protection is classified as active or passive:

- **Passive** systems include guardrails, covers and safety nets
- **Active** systems include:
  - **Work positioning**: Allows you to work hands-free
  - **Fall restraint**: Prevents you from falling off an edge or into an opening
  - **Fall arrest**: Catches your body after you have fallen

When planning to use personal fall protection, consider free fall, clearance and swing fall:

- **Free fall** is the distance traveled from the point where you start falling to the point where your fall protection system begins to slow you down
- **Clearance** is the distance required for your personal fall arrest equipment to activate, decelerate and then completely stop your fall
- **Swing fall** can occur when you walk away from under your anchor point. When you fall, you will swing back under your anchor point like a pendulum

Fall Protection Equipment
Personal fall protection includes the following components:

- **Body support** includes a full body harness
- **Connectors** may be lanyards, snaphooks or carabiners
- **Anchor points** are the points at which you attach your anchorage connector
  - Use anchor points that are as high as possible and located at least at D-ring level
  - Anchor to a structure that can handle a 5,000-pound load or that a qualified person has identified for you
  - Make sure you have enough clearance for your fall protection system to stop you before your body strikes an object below
- **Self-Retracting Lifelines (SRLs)** require much less clearance than a lanyard and allow more freedom of movement
- **Vertical** and **horizontal lifelines** are also used on some worksites

Inspecting and Maintaining Equipment
You must inspect fall protection equipment before every use

- Inspect body support more frequently when welding or working with chemicals or sharp edges
- Inspect connectors periodically throughout the day

A qualified person must also inspect equipment annually.

If equipment is ever involved in a fall, even if it does not show signs of damage, remove it from use and return it to your supervisor.

To keep your fall protection equipment working, you must:

- Store equipment properly
- Never throw it into a storage box
- Keep it dry and clean
- Keep it out of direct sunlight

Fall Protection: Rescues

Anatomy of a Fall
The basic parts of a personal fall arrest system are the:

- Anchor point
- Lanyard
- Harness with D-ring

Make sure your personal fall arrest system will:

- Prevent deceleration injuries
- Function without mechanical failure
- Prevent you from contacting obstructions

If the fall arrest system is set up correctly:

- The lanyard halts your fall
- You are clear of obstructions
- You remain securely in the harness

Injuries
External injuries from contact obstructions during a fall may be obvious. For example, it's likely you will notice broken bones, lacerations or impalement.

Internal injuries, such as internal bleeding or bone fractures, are often less obvious. These injuries can be every bit as life-threatening as those you notice right away.

Suspension Trauma
Fallen workers stop in a vertical position with their head above their legs.

The muscles you use to move your limbs pump the blood there back to the heart. If your legs are immobile, gravity can make blood accumulate or pool.

The pressure of the harness straps on your body can also prevent blood from flowing from the limbs to the heart, brain and other organs.

When blood flow is restricted, suspension trauma occurs:

- Decreased blood pressure
- Increased heart rate
- Fainting

For fallen workers awaiting rescue, suspension trauma can become a life-threatening emergency in as little as 10 to 15 minutes.

Remember that fall-related deaths do not always begin with bleeding and broken bones. The effects of suspension trauma get worse the longer the victim stays motionless. A worker who can't move or who faints after a fall needs immediate help.

Minimizing Suspension Trauma
Alert someone IMMEDIATELY. Contact rescuers or someone who can reach them.
Communicate any way you can:

- Voice communications
- Whistles
- 2-way radios

Safely keep your blood flowing:

- Make controlled movements
  - Do not jerk/make erratic movements
  - Do not move in a way that causes more injury
  - Do not damage the lanyard
- Use suspension relief straps to "stand"
- Stand on or push off nearby structures

Rescue Planning
Each worksite must have a **fall protection plan** that:

- Addresses:
  - Specific fall exposures at the site
  - Fall suspension trauma
  - Time and resources for rescue and first aid
- Identifies individuals who will assist in emergencies
- Names an incident commander
- Explains how to coordinate with local emergency services
- Includes rescue backup plans
- Identifies medical care options

Your company may invite local responders to visit your site for planning purposes. Companies should identify, obtain and set aside rescue equipment. Train incident coordinators and assistants about how to use the equipment.

Determine how to safely get victims to the ground or nearby structures:

- Elevated work platforms, such as scissor/aerial lifts
- Ladders
- Extension poles
- Crane suspended platforms (only as a last resort)
- Technical rescues, such as those involving winches, rigging and climbing (only as a last resort)

To access fallen victims safely, consider:

- Terrain
- Hazards, such as structures and powerlines
- Weight of rescuers, equipment and victims

We don't want the toxins in pooled blood to release all at once and overwhelm the body's organs. Place rescued victims in a **sitting position with knees close to the chest** to gradually restore blood flow. Inform rescuers how long victims were suspended so they can decide what to do.

Job Hazard Analysis (JHA)

A JHA, also called a job safety analysis (JSA), is a process by which we identify the potential **hazards** for each step a person takes to perform a task and the **controls** we can use to eliminate or reduce **risk** and prevent **incidents**.

JHAs answer important questions like:

- What could go wrong?
- How could an incident happen?
- How likely is an incident?
- What are the consequences of the incident?
- How can we eliminate hazards or reduce risk to an acceptable level?

A JHA can help you:

- Implement effective safety controls
- Create and update safe work procedures
- Standardize best practices
- Develop valuable training
- Comply with applicable regulations
- Raise safety and health awareness

The result is a safer work environment with fewer injuries and illnesses, more effective work practices and increased productivity.

JHA Process

Exact JHA processes may vary, but they generally involve four steps:

1. Select and prioritize the jobs or tasks to analyze.
2. Break each job or task into a sequence of detailed steps.
3. Analyze each step and identify the potential hazards.
4. Determine which controls will eliminate or reduce risk to an acceptable level.

One person may lead the JHA, but many people should provide input. **Experienced workers** care about safety and can offer insight about past incidents and near misses. **New workers** offer a fresh perspective and may notice hazards that experienced workers may miss. Workers who perform **similar tasks** or the same tasks in a different setting may share information about their hazards and controls. Health and safety professionals, supervisors and other **leaders** are often responsible for implementing controls and may offer specialized information.

Step 1: Select and Prioritize Tasks to Analyze

- Review records and reports about previous incidents, near misses and concerns
- Talk to workers
- Look for new or newly changed processes
- Prioritize tasks according to their risk

Step 2: Break Tasks into Steps

- Use verbs that describe what workers are doing to start each step
- Consider breaking long lists of steps into groups and doing a JHA for each group
- Review and revise steps with experienced workers

If you omit a basic step, you may miss a hazard or control later in the process. You may determine the steps that are part of a job or task by reviewing documented work procedures and using discussions and observations.

When you discuss steps or observe people, remember to:

- Use safe practices and stay aware of your surroundings
- Avoid causing distractions or hazards
- Introduce yourself
- Let them know your purpose
- Ask if they are comfortable talking to you or being observed
- Follow your company's policies if you are recording people
- Ask workers to work safely and slowly and describe what they are doing, if possible
- Correct any safety issues that put people in danger
- Share what you learn

Step 3: Analyze Steps and Identify Hazards

- Can body parts get caught in or between objects?
- Does housekeeping contribute to slips, trips or falls?
- Could lifting, pushing or pulling tasks cause sprains or strains?
- Is noise or vibration a problem?
- Is lighting sufficient?
- Does the step involve hot, toxic or caustic substances?

Cleary and concisely document each hazard for the corresponding task step. Review the hazards you identify with the people you observed or talked to about the steps.

Step 4: Determine Controls to Reduce Risk

- Clearly and concisely document the controls for each hazard
- Get input from others
- Make sure controls don't introduce new hazards

The hierarchy of controls lists controls in order of their effectiveness. For the best results, use a combination of controls.

1. Eliminate risk by redesigning the process
2. Substitute with a safer process or product
3. Provide engineering controls at the source
4. Reduce exposure through administration
5. Use personal protective equipment (PPE) as a final barrier between people and hazards

After the JHA

Implement controls. Communicate your needs clearly and identify completion dates or deadlines. Follow up with the people who helped you complete the JHA so that they know that their input was valuable. Use the hazards and controls in your JHA as topics for upcoming safety newsletters and safety meetings to raise awareness about safety and health issues. Confirm that the controls are working as expected and haven't introduced any new, unexpected hazards.

Update the JHA or create a new one when equipment, materials, processes or the environment change. Schedule regular reviews and updates for JHAs, such as annually. Review the JHA after an incident, such as an injury or a near-miss.

Pre-Job Briefings

What Is a Pre-Job Briefing?

A pre-job briefing is a meeting between leadership and the crew to discuss:

- Hazards associated with the job
- Work procedures, roles and responsibilities
- Special precautions
- Energy-source controls (including lockout/tagout)
- Personal protective equipment (PPE) to be worn during the job

When Does a Pre-Job Briefing Take Place?

- Before the job begins
- When assignments have changed or new personnel are involved
- When there are significant changes in scope or working conditions
- After a break in activity
- Following an accident or upset condition

How Is a Pre-Job Briefing Conducted?

1. The person in charge defines the scope of the work and determines if the task is routine or non-routine.
2. Potential workers are then assembled, preferably at the jobsite, and perform a walkdown (area inspection). Worker experience is assessed, and roles and responsibilities are assigned.
3. Specific work activities, hazards, special precautions (including what to do in case of an emergency), energy-source controls and required PPE are discussed, and any questions are answered.
4. Subject matter experts may be involved, as needed, to review permits or specific job details.

What Questions Should Be Asked in a Pre-Job Briefing?

- Do you understand your role and responsibilities and your work scope?
- Do you know the critical steps in this activity as they relate to your assignment?
- What are the potential hazards associated with the job and how will we control them?
- What is the worst thing that can go wrong and how should we respond?
- What errors or lessons have you observed in the past with similar tasks?
- What are the PPE requirements, permit limits, site and weather conditions, and other factors that could affect safety?

How Should a Pre-Job Briefing Be Documented?

It is a best practice to keep a record of the pre-job briefing, which should include the:

- Date
- Time
- Attendees
- Topics covered

Example Pre-Job Briefing Form

PRE-JOB SAFETY BRIEFING

Job Task or Work Order #: _____ **Date**: _____

Objective: *Ensure worker understanding of assigned work and effective identification, evaluation and control of task-specific safety or health hazards.*

Define task scope (be specific):

☐ Routine ☐ Non-routine

Worksite conditions (What could impact health & safety?):

Hazard(s): ☐ Caught-on ☐ Caught-in ☐ Slip/Trip ☐ Electrical ☐ Heat/Cold ☐ Chemical(s)
☐ Caught-between ☐ Struck-by ☐ Rigging ☐ Fall (same/lower level) ☐ Airborne ☐ Soil
☐ Hot work ☐ Noise ☐ Ergonomic ☐ Traffic

Hazard energy source(s):

Documentation & work authorization permit(s): ☐ Lockout/Tagout ☐ Permit-required confined space ☐ Hot work ☐ Job hazard analysis ☐ PPE certified hazard assessment

Control(s) & limitations:

Error precursor(s): ☐ Time pressures ☐ Non-routine work ☐ Work-arounds ☐ New task ☐ Fatigue ☐ Inaccurate risk perception ☐ Multi-tasking ☐ Inexperience ☐ Tooling

Critical steps: (1)
(2)
(3)
(4)

WHAT IF: Team members shall spend time challenging conventional wisdom by asking "what if?" This conversation ensures permits, controls or layers of protection reduce operational risk associated with each critical step. Top management should take an active role in this pre-job briefing step.

Human factor(s): Verify all bolded factors ensure at least two additional factors are in place before starting**.**

☐ **Training** ☐ Independent observation ☐ Validate assumptions ☐ Peer check
☐ Self check ☐ 3-way communication ☐ Post-job briefing
☐ **Correct procedure(s)** ☐ S.T.A.R. (situation, task, action & result)
☐ **Stop work authority**

Emergency preparedness:

Non-routine or emerging work scope change(s):

Crew supervisor name: _____ **Date:** _____

Lone Worker: Concerns

Lone workers face the same hazards as other workers, but they are at greater risk due to their isolation. It's important that you understand these risks so that you can prepare to work safely.

What Is Lone Work?
Lone workers:

- Aren't closely or directly supervised
- May be unable get immediate assistance
- May also be called remote or isolated workers

Lone workers may be isolated by time, distance or area configuration. Being a lone worker simply means that, at some point, your work isolates you from others.

Some examples of lone workers include:

- Utility field service technicians
- Drivers and delivery people
- Overnight workers
- Surveyors
- Agricultural and forestry workers
- Realtors
- Remote workers or telecommuters

Some jobs present such a high level of risk that **no one** should do them while isolated in terms of time, distance or area configuration. Examples include:

- Work in permit-required confined spaces
- Work near energized electrical conductors
- Diving operations
- Using vehicles to transport explosives or fumigation materials
- Elevated work that requires fall arrest equipment

Health and Safety Risks
Lone workers face the same health and safety hazards as anyone else. They face greater risks because they may not have anyone to assist them or help them if things go wrong.

Lone work means that there is no one else to assist with tasks such as lifts, identify avoidable dangers, or provide aid and notify others of an incident.

Time isolation could result in working alone in dangerous situations, such as when a worker is alone in a building when a fire starts in another room.

Distance isolation could result in having difficulty getting new equipment, tools and materials when unplanned situations arise, such as an unexpected repair.

Area configuration isolation could result in people not realizing others are in danger or distress right away, such as being stuck in a walk-in freezer.

It's CRITICAL that lone workers think about everything that can go wrong and plan accordingly.

Lone Worker: Risk Assessment

Lone workers are isolated from others by time, distance or area configuration. They aren't closely or directly supervised and may not be able to get immediate assistance. It's CRITICAL that lone workers think about the things that can go wrong and plan accordingly.

Risk Assessment
Risk assessments:

- Identify hazards and how likely they are to cause harm
- Are the first step in deciding how to prevent or control hazards
- Should account for normal work and foreseeable emergencies
- Are both formal and dynamic
- Consider tasks, locations and personnel
- May be digital or on paper

Formal risk assessments document what we know about the hazards, risks and precautions typically associated with the work. They use insight, history and experience to predict potential hazards.

Work situations are dynamic; they constantly change. When new risks occur to us, we need to assess them to determine if we need new precautions. **Dynamic risk assessment** refers to the assessment of risks as they occur to us. Lone workers should account for any new information about hazards and controls when they arrive at the site and update the risk assessment before, during and after the work.

Employers may require lone workers to talk to a supervisor when plans change. All employees have the authority and responsibility to stop work if unacceptable risks are present or if they have concerns or questions about safety.

Lone workers should update risk assessments after the work is complete. Note any concerns, near-misses or incidents. To improve future risk assessments, supervisors may ask follow-up questions

Task, Tool and Resource Considerations
Lone workers must think about the tasks they will perform, the tools they will use and the materials with which they will work when they consider possible hazards. Lone workers may need tools, equipment and materials; personal protective equipment (PPE); and safe transportation.

Consider any historic data or reports and the experience of others when assessing risks associated with tasks, tools and resources. This includes personal experience and the collective experience of the company or industry. Even experienced lone workers can benefit from the perspectives of others!

Resources for information may include near-miss and incident reports; safety procedures; chemical safety data sheets (SDSs); and input from safety representatives; supervisors; and site experts and owners.

Location Considerations

Lone workers should consider hazards where they are going and hazards along the way, such as ice walkways, traffic and fog, dense vegetation and rough terrain. Check the weather forecast to plan for storms, temperature extremes and other adverse conditions. Consider communication quality including if lone workers may charge devices and how weak signals may be in some areas.

Consider how to access and secure facilities and how to describe the location, using an address or coordinates, in an emergency.

Are animals, insects or plants present? Are there any disease outbreaks, crime patterns or civil unrest in the area?

Personal Considerations

All lone workers should have appropriate training regarding tasks, hazards and emergency procedures. Inexperienced lone workers should have access to advice or guidance.

Lone workers may need to accommodate impairments such as to their vision or hearing. Consider the health conditions that may affect the lone workers, such as asthma, allergies or family histories of heart attack or stroke.

Using Check-Ins to Monitor Lone Worker Safety

Employers must monitor the safety of lone workers. The risk assessment should identify the safety monitoring plan, methods and frequency. The risk assessment should also identify emergency procedures.

Before they leave, lone workers should submit details of their itinerary including routes, contacts and times to their supervisors or personnel who will monitor their safety. Keep records of detailed vehicle descriptions. If lone workers are traveling over great distances or long periods of time, ensure safe and adequate accommodations.

Lone workers should notify their supervisors any time they deviate from a planned itinerary.

Monitoring the safety of lone workers often involves a lone worker "checking in" with a supervisor or designated person using an audio or video call, a radio, an email or a mobile application. Employers may also monitor the safety of lone workers using technology such as motion sensors or a global positioning system (GPS). Monitoring communication devices may include an emergency alert option that lone workers can quickly press to get help.

ALL these methods of monitoring for safety require power and connectivity of some kind. Test them and plan backup methods of checking in, as needed.

Employers may require check-ins from lone workers at certain frequencies or milestones. Safety monitoring devices may transmit status in real-time. Failure to check-in will trigger emergency procedures. Lone workers should keep their emergency contact information up to date with their employers.

Culture of Early Reporting

Value of Early Reporting
Early reporting:

- Makes it easier to identify and address problems before they are problems
- Draws attention to process improvement opportunities
- Increases hazard recognition, vigilance and preparedness
- Enables continuous and systematic learning (more data to analyze)
- Improves productivity
- Reduces time and revenue lost due to incidents
- Helps create a proactive culture of safety

Challenges of Early Reporting
EMPLOYEES may perceive early reporting as something that is:

- Not part of their job
- Risky
- Futile
- Difficult or time-consuming
- Discouraging without knowing what to look for
- Less important than production

From a MANAGEMENT viewpoint, early reporting can be dwarfed by competing priorities.

Strategies to Encourage Early Reporting
Promote the Value of Early Reporting
Promote the value of early reporting by:

- Reviewing corrective and preventive actions to improve work systems
- Promoting information sharing
- Crediting those involved in identifying, reporting and acting upon issues

Create a Culture of Early Reporting
A culture of safety includes:

- Communication
- Learning
- Feedback
- Buy-in
- Teamwork
- Well-qualified, passionate staff
- Positive perception of safety
- High expectations
- Accountability for corrective actions and clear hand-off procedures
- Transparency about safety incidents

Managers/supervisors should:

- Never take the obvious for granted
    - Make sure employees know you have a reporting system

- Make sure employees are never "too busy" to report
    - Make reporting part of the routine/process/job
    - Schedule time for safety
- Demonstrate the value of early reporting
    - Engage employees in devising and implementing corrective actions
    - Communicate when and how problems were solved

Encourage Reporting

Frontline EMPLOYEES are more likely to report when their supervisors:

- Treat them as subject matter experts
- Take their suggestions seriously
- View safety as a critical priority
- Conduct safety briefings
- Frequently encourage reporting

Frontline SUPERVISORS are more likely to report to senior managers who:

- View safety as a priority
- Review safety data frequently
- Assign responsibility for the reporting system to a direct report

Convert Reporting to Learning

Increased reporting results in learning ONLY when it is part of a systematic approach.

For reporting to result in learning:

- A culture of safety has to exist
- Safety and learning must be infused into daily activities and routines

What If? Mentality

A **"What If?" mentality** is looking at any scene or situation and thinking about what could happen based on your observations.

A "What If?" mentality can help you **prevent near-misses and serious incidents** by recognizing dangers and predicting how safe conditions and behaviors can improve safety.

Use EVERYTHING you see when you are observing and think ahead to what could go wrong.

You can even apply "What If?" thinking without people or equipment present.

A "What If?" mentality isn't always about spotting problems that you need to correct; it can also be about spotting problems that people have already addressed.

Inspections and Observations

Why Inspect and Observe?
The most important reason to inspect and observe is to prevent people from being hurt or killed. Other reasons to inspect and observe are to:

- Create a culture of safety
- Identify, understand and replicate safe work processes, practices and conditions throughout the organization
- Avoid missing things
- Prevent complacency
- Raise safety awareness
- Eliminate barriers to safe, efficient production
- Meet regulatory requirements and avoid liability

React to Negative Perceptions
To improve negative perceptions of observations and inspections:

- Create an environment free of reprisal for observations
- Encourage EVERYONE to observe
- Recognize good, safe work practices
- Find and fix the *real* reasons for safety issues
- Follow up to make sure hazards are corrected
- Inform affected people of progress

When you are a **safety advocate**, employees:

- Expect you to be an educator and expert
- Demand you take their suggestions seriously
- Rely on you to escalate their concerns
- Believe that you care about them

Prepare for Inspections and Observations
When you plan to inspect and observe:

- Be an expert about company and regulatory requirements
- Use incident and observation records to identify areas to focus on
- Allot a sufficient amount of time (don't rush)
- Involve the right people (experts, other managers, etc.)
- Use checklists to remind you about safety requirements and things to look for

Best Practices for Inspections and Observations
Good observers should:

- Be hyperaware
- Think ahead
- Trust their instincts
- Be open-minded
- Have conversations
- Be OK with finding nothing wrong
- Correct problems and praise good ideas as soon as possible
- Know the process for notifying supervisors

When you inspect or observe:

- Announce your presence to workers
- Warn workers if you plan to take pictures
- Resolve problems immediately, if you can, and document what you did
- Remove or block hazards if you can't resolve them
- Communicate about hazards

When you want to **provide feedback** to someone you are observing:

- Don't be a distraction
- Make eye contact and ask the person to stop

Safe Behavior

If you observe people using safe behaviors:

- Find out why they are doing what they're doing
- Commend them
- Follow up with their supervisor/manager

Unsafe Behavior

If you observe an unsafe behavior or condition:

- Let the worker know what you observed and explain what's wrong
- Find out why it happened
    - Get to the root of the issue
    - There is often a systemic reason for an unsafe condition
- Provide guidance (worker avoidance or company solution)
- Follow up with the supervisor or area manager

Documenting Findings

When you document your findings:

- Be as detailed as possible
- Assign risk classifications to risks and hazards
- Recommend corrective actions that target underlying causes
- Assign corrective actions with due dates

Remember: It's OK to find nothing wrong!

After an Inspection and Observation

To follow up, you should:

- Schedule and monitor corrective actions
- Send formal memos or reports to management
- Provide guidance about budgeting, scheduling and implementing
- Verify and document that corrective actions are in place
- Follow up with employees involved in the process

Continue to inspect and observe!

Giving and Receiving Feedback

To receive feedback:

- Think about how you usually respond to feedback and break bad habits
- Separate the feedback from the person
- Give feedback due consideration
- Start with small changes

Unproductive Ways to React to Feedback

Some bad habits to avoid include:

- Defending yourself
- Arguing
- Hiding your emotions
- Criticizing the messenger
- Ignoring the feedback

How to Give and Receive Feedback

When you **receive** feedback:

- Separate the feedback from the person
- Give feedback due consideration
    - Ask what the observer noticed and expects
- Try advice/change on a small scale first
- Ask about the outcome the person expects
- Ask for one specific thing you can change

When you observe and then **give** feedback, keep the following in mind:

- Enable safe work
- Ensure next steps are clear and agreed upon
- Make sure safety is EVERYONE'S responsibility (not just yours)
- Build relationships

Characteristics of Effective Feedback

DO:

– Explain your purpose
– Assume people may not know the risks
– Lead with the positive
– Be timely and specific
– Stay calm and express concern
– Be personable
– Restate what you heard
– Thank the person

DON'T:

– Distract workers
– Assume you know what is wrong and how to fix it
– Make it personal
– Be vague/general
– Write while observing

Reporting (Data Entry)

In general, you should **complete reports immediately after your observation and initial mitigation**. You can make revisions to the report when you find more information.

Benefits of Documenting Observations and Incidents
Reports can help you:

- Identify trends
    - Predict and prevent further incidents
    - Apply global changes
- Provide an objective measure of how often something is happening
- Show commitment to safety
- Increase awareness, correction and closure
- Learn from common experiences
- Recognize and reinforce safe work

Characteristics of Effective Reports
Use positives to drive change, not just negatives. A good guideline is to document four positive observations for every negative observation. Offer praise and share successes.

You still need to report incidents, even when you are able to correct them immediately!

When you use report forms:

- Select the appropriate form for what you have to report
- Include your name (if required), the date and location of the incident, and other details
- Provide pictures, videos and sketches
- Select an appropriate risk rating

When you write report narratives:

- State what you saw (include pictures, videos and sketches)
- Explain what you did
- Describe what needs to be done
- Be clear, concise and specific
    - Avoid being general/vague
    - Use simple language
- Be objective
    - Avoid adjectives, opinions, judgment and embellishment
    - Avoid allegations of fault and noncompliance
    - Keep names out of reports and use job titles instead
- Follow up in-person with managers and supervisors

Incident Investigation

By understanding what incident investigation and causal analysis are and how you can help, you can prevent accidents and make a safer workplace – before losses occur.

Concepts and Terms

- **Incident**: Unwanted event that could reduce productivity or cause danger
- **Near miss**: An incident without losses and an indicator that a condition or practice could cause injury/damage
- **Accident**: An incident resulting in loss/injury
- **Causal factors**: Direct or indirect factors contributing to the occurrence of incidents
- **Direct costs**: Immediate costs of an incident, such as property loss
- **Indirect costs**: Secondary costs of an incident, such as lost productivity

Investigation Basics

WHY do we typically conduct incident investigations?

- To comply with laws and regulations
- To help protect us from liability
- As part of the overall insurance claim submission processes
- To prevent the same or similar incidents from happening again

WHEN do we typically conduct incident investigations?

- After incidents
- When people submit observations
- During proactive audits, inspections or observations

WHO should be involved in incident investigations?

- Anyone with input
- A variety of people/perspectives (not just the supervisor or safety professional)

Incident Management

After you've been notified of an incident or observation and addressed all medical issues and secured the scene:

1.	Identify losses (if any) and gather information.	**Investigative Process**
2.	Analyze the information, determine the reasons (or causal factors) and prioritize the risks.	
3.	Develop action plans.	
4.	Track all associated tasks and report corrective action progress.	
5.	Identify and eliminate risks.	
6.	Record and share what you learned during the process.	

Information Gathering

Begin an investigation as early as possible and repeat it to achieve the best results.

Complete information gathering as soon after an incident, near miss or observation as possible. If you need to make changes to improve safety, make note of the "before" and "after" conditions.

Some of the ways you may gather information include:

- Documenting
- Interviewing
- Photographing
- Sketching
- Collecting
- Reenacting

Interviews

During interviews:

- Avoid judgment and be humble
- Collect personal accounts
- Choose a convenient time
- Choose a private place near the scene
- State the purpose of the interview
- State how you'll use the information
- Show curiosity, interest and concern
- Focus on listening and learning
- Don't lead witnesses into answers
- Show and explain your notes
- Close with thanks and next steps

Photos/Sketches

When you take photos and draw sketches:

- Make a visual representation of the scene
- Capture relative positioning of evidence, damages and anything that seems out of place
- Consider witness perspectives/vantage points
- Include size and color references if these details are important
- Take pictures BEFORE you collect evidence

For major incidents, don't delete "bad" photos. If you do so, people may accuse you of trying to prove your opinions are right instead of trying to document the truth.

Physical Evidence

Physical evidence can be used to test causal theories. After incidents, establish a **chain of custody** and protect and preserve physical evidence from damage and contamination. If you have any questions about what evidence to preserve or document, consult your management or corporate counsel.

Benefiting from Investigative Findings

To make the most of your investigative findings, you should communicate incident details and look for trends:

- Multiple near misses predict higher accident probability
- Training about a safety topic may lead to fewer incidents
- Fast corrective actions predict low incident likelihood

Causal Analysis

There are many causal analysis methods. No single method is best for all types of investigations. Regardless of the method you use, it's important to remember that accidents don't simply happen because someone makes a mistake. We need to understand why someone made a mistake. Asking "**Why?**" is a simple causal analysis approach in which you simply ask why as many times as you need to in order to get to the causal factor.

Tasks and Corrective Actions

Structuring Hazard Controls
There are five general methods, in descending order of effectiveness, for controlling hazards:

1. ELIMINATE IT by redesigning the process.
2. SUBSTITUTE IT with a safer process or product.
3. Provide ENGINEERING CONTROLS at the source.
4. REDUCE exposure through administration.
5. USE PPE as a last resort.

The best corrective actions are often a **combination of hazard controls**.

Encourage reporting to identify system weaknesses and hazard control ideas!

Solely relying on training and procedures to address issues that are about work areas and equipment is almost never the best idea; consider adding other controls.

If you determine that training, procedures and counseling are the primary corrective actions being taken, your causal analysis may be too superficial!

Systemic issues can affect multiple people in multiple areas.

Choosing and Implementing Corrective Actions
When you consider how to choose and implement corrective actions, think about:

- Risks/Hazards
- Severity
- Frequency
- Probability
- Cost

Your goal is to mitigate risk to a more tolerable level.

As you plan corrective actions, remember that:

- Workers may need training about the actions you implement
- You may need to update procedures, job hazard analysis forms and training materials to account for changes
- Habits may be difficult to change; practice is necessary

Involve employees BEFORE your decisions about corrective actions to:

- Show that you care
- Take advantage of their experience/expertise
- Get them to own the solution

Make controls as easy as possible. The benefits should exceed the difficulty.

Timelines
Remember:

- The higher the risk, the faster you need to implement corrective actions
- For high or extreme risks, isolate the hazards until a solution is ready
- Document your recommendations on which actions deserve highest priority and funding and provide them to management
- Plan for corrective actions that require capital expenditures
- Identify the appropriate responsible parties for each action and establish a realistic completion timeline
- Systems accountability is critical, especially for long-term solutions

Leading companies take action as soon as possible. You may even be able to implement some corrective actions immediately or within 48 hours.

Monitoring
Monitor and determine the effectiveness of corrective actions.

You may need to adjust your plans and timelines.

Don't forget to follow up with employees to let them know about progress and completion!

After controls are in place, employees can help:

- Test corrective actions in the field
- Monitor effectiveness over time
- Provide feedback
- Make sure theoretical solutions work well in practice

Evaluating and Prioritizing Risks with a Risk Matrix

Many people use a risk matrix to assess risk before and after corrective actions. The following is a SAMPLE risk matrix.

Likelihood / Consequence	Level	**Rare** The event may occur in exceptional circumstances. Less than once in 2 years	**Unlikely** The event could occur at some time. At least once per year	**Moderate** The event will probably occur at some time. At least once in 6 months	**Likely** The event will occur in most circumstances. At least once per month	**Certain** The event is expected to occur in all circumstances. At least once per week
		1	**2**	**3**	**4**	**5**
Negligible No injuries. Low financial loss.	**0**	0	0	0	0	0
Minor First-aid treatment. Moderate financial loss.	**1**	1	2	3	4	5
Serious Medical treatment required. High financial loss. Moderate environmental implications. Moderate loss of reputation. Moderate business interruption.	**2**	2	4	6	8	10
Major Excessive, multiple long-term injuries. Major financial loss. High environmental implications. Major loss of reputation. Major business interruption.	**3**	3	6	9	12	15
Fatality Single death.	**4**	4	8	12	16	20
Multiple Multiple deaths and serious long-term injuries.	**5**	5	10	15	20	25

Risk Rating	Risk Priority	Description
0	N	**No Risk:** The costs to treat the risk are disproportionately high compared to the negligible consequences.
1 – 3	L	**Low Risk:** May require consideration in any future changes to the work area or processes, or can be fixed immediately.
4 – 6	M	**Moderate:** May require corrective action through planning and budgeting process.
8 – 12	H	**High:** Requires immediate corrective action.
15 – 25	E	**Extreme:** Requires immediate prohibition of the work process and immediate corrective action.

Continuously Improve for Safety Excellence

What Is Continuous Improvement?
Continuous improvement is a quality management concept that starts with the assumption that quality can always be improved.

The goal of continuous improvement is to identify and eliminate EVERY defect, error, inefficiency and process variation, rather than accepting a "reasonable" level of imperfection.

Benefits of Continuous Improvement
Continuous improvement can help organizations:

- Remain competitive
- Provide superior products and services
- Protect the health and safety of employees
- Meet or exceed governmental or other industry compliance
- Apply standard principles to address any issue
- Improve product and service quality
- Improve efficiency and productivity
- Increase employee job satisfaction and morale

Continuous Improvement Workflow
The continuous improvement workflow is:

- **Plan**
  - Recognize an opportunity and plan a change
- **Do**
  - Test the change with a small-scale study
- **Check**
  - Review the test, analyze the results and identify what you've learned
- **Act**
  - If the change did NOT work in the small study, go through the cycle again with a different plan
  - If the change DID work in the small study, incorporate what you learned on a wider scale
  - Use what you learned to plan new improvements, beginning the cycle again

Lagging and Leading Indicators
Lagging indicators are metrics that measure and group safety and health data and results from the past, such as:

- Incident rates
- Lost work days
- Workers' compensation claims
- Losses

Leading indicators focus on present conditions, behaviors and variables that predict future events. They can help us track and correct errors, process flaws and other potential shortcomings *before* serious incidents, injuries and illnesses occur.

Monitoring leading indicators allows you to:

- Highlight the importance of employee efforts to prevent injuries and illnesses
- Improve accountability

- Give credit for work well done
- Take corrective action before an incident, injury or illness occurs

Leading indicators tend to measure ACTIVITIES people can CONTROL.

By looking at both leading AND lagging indicators, a company can tell if its efforts are producing desired results.

The shift to add leading indicators to lagging indicators requires:
- Investing more resources in inspections and observations
- Shoring up reporting practices
- Creating an early reporting culture
- Defining safety systems
    - People responsible
    - Activities performed
    - Means to measure effectiveness

How Quality Management Improves Safety Performance
Companies should consider their workplace, goals and personnel when choosing the tools and combinations of approaches that make sense for them.

For example, they may use:
- Six Sigma
- Lean
- Change management
- Lessons learned

Quality management tools help organizations:
- Improve training effectiveness
- Increase skill level of employees
- Increase employee participation
- Improve the effectiveness of safety management systems
- Investigate incidents sooner

Integrated Systems – Achieving Organizational Excellence

Integrated systems include:

- **Compliance** – Meet regulatory standards
- **Risk Management** – Assess risks and control loss
- **Leadership** – Involve senior managers and drive top-level decisions
- **Culture** – Incorporate safe culture-building activities and regularly measure results

Organizational Best Practices that Support Integrated Systems

Organizational best practices include:

- Encouraging greater cross-functional collaboration between departments
- Integrating health and safety with other functions/departments
- Measuring data and incorporating leading indicators
- Basing decisions and programs on evidence
- Optimizing management systems and processes
- Implementing occupational health and safety (OHS) management technology

Benefits of Integrated Systems

- **Compliance** ensures every company in a given industry meets the same minimum standards
- **Risk management** impacts many competitive variables, from incident-related costs to corporate reputation
- **Leadership** is one area where a company can really distinguish itself from its competitors by making sure senior management makes decisions and creates policies geared toward the same goals
- A **culture** of safety gives companies a clear advantage by proactively preventing health and safety incidents rather than reacting to them after they happen

Ways to Implement or Strengthen Integrated Systems

When creating, analyzing or identifying improvement opportunities in any **management system**, consider:

- Policies
- Health/safety best practices
- Hazard recognition
- Training
- Accountability/enforcement
- Engineering/design
- Risk assessment/acceptance
- Excessive workload/conflicting demands
- Metrics
- Documentation

Evaluate your overall **leadership**:

- Determine the best qualified decision-makers

- Evaluate information flow
- Communicate decisions clearly
- Encourage reporting without fear of reprisal
- Identify and reward individuals who do the right thing

Culture includes the collective values, beliefs, attitudes and norms that shape individual perceptions and behaviors.

A **culture of safety** gives companies a clear advantage by proactively preventing health and safety incidents rather than reacting to them after they happen.

Remember that outcomes depend largely on individual choices and behavior. That's why top performers invariably invest as much effort in strengthening the safety and health culture as they do on other activities.

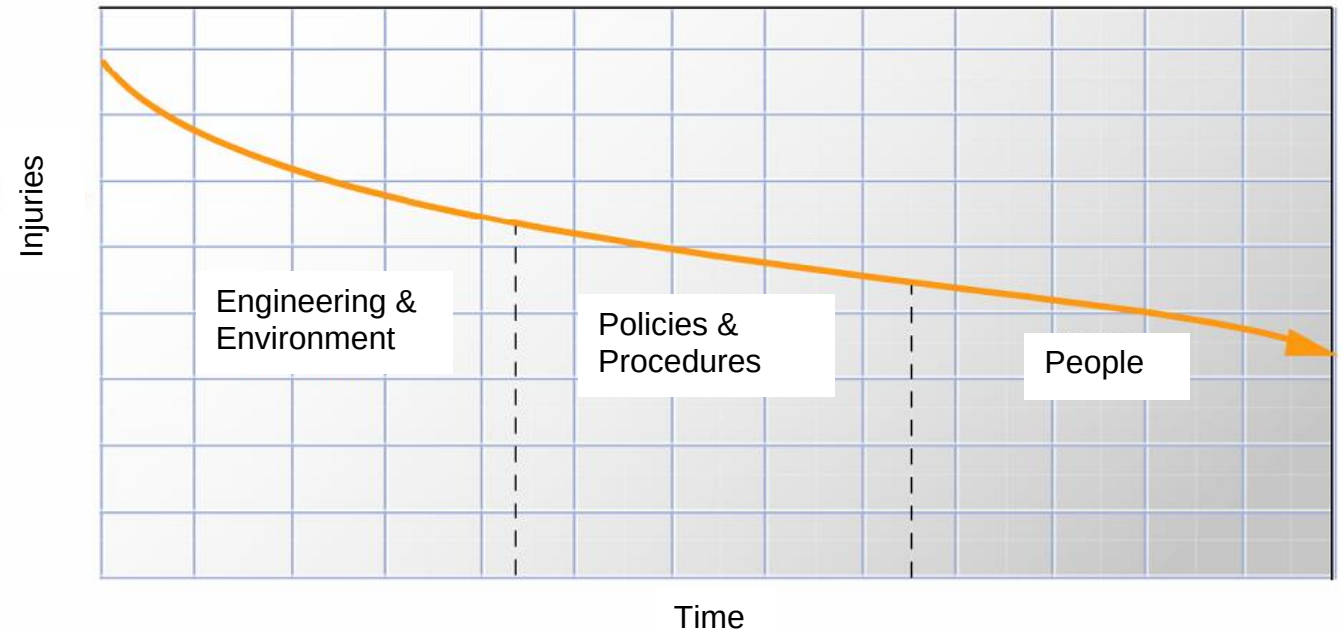
Benefits of Commitment
Creating a culture of worker safety and health results in:

- Decreased accident rates
- Lower turnover
- Less absenteeism
- Higher productivity

Safety and You for Supervisors

You as a supervisor shape the culture in which you work by your actions – that is, by what you do and say. You can even affect the culture by what you do not do. For example, if you notice an employee not wearing the proper personal protective equipment, don't ignore it. Stop and address the situation. However, a supervisor is NOT a watchdog trying to catch employees doing something wrong. It is important for a positive culture to provide feedback for doing things right.

Evolution of Safety Performance
Supervisors address all three aspects of safety – the engineering and environment, the policies and procedures, and the people.



1. **Engineering and the environment.** Eliminate as many hazards as possible in the workplace and working environment. Address environmental exposures with appropriate engineering controls to reduce injuries and potential injuries.
2. **Policies and procedures.** After addressing engineering and environmental concerns, develop and implement policies, procedures and management systems to ensure safe work practices that prevent accidents and injuries. When the necessary policies and procedures are in place and employees have been trained on them and are using them effectively, injuries and potential injuries should reduce further.
3. **People.** The actions and attitudes of people operating within and around our work environment determine safety performance.

Common Reasons for Risks
Even with engineering controls, safe working environments, and effective policies and procedures, we still encounter employee injury and even death. People don't want to get hurt, so why do they take risks?

1. Workplace conditions encourage at-risk behavior. Equipment may be hard to use safely. Personal protective equipment (PPE) may be awkward-fitting or ill-maintained. Workers may feel pressured to get the job done "at any cost."
2. They are unaware the behavior is at-risk. They may not have been trained, don't receive reminders, and there may not have been a previous incident from unsafe actions. As a supervisor, communicate about safety (post and share safety-related information, hold team meetings to discuss safe behavior, begin each day with a toolbox or tailgate talk, have pre-task planning discussions before any high-risk task). If you are not reinforcing safety, you are allowing workplace experience to define safe and acceptable work practices. Continually reinforce safe ways of working, hazards and shortcuts to avoid.
3. Natural rewards and punishments usually favor unsafe behavior. Risky shortcuts offer a natural reward by usually being faster, more convenient and more comfortable. They rarely results in injury on any single occasion. It's human nature to take the risk when rewards are virtually certain and the risk is low.

How to Use Rewards Versus Discipline

Potential disadvantages of discipline include:

- Tends to focus on an individual's actions rather than the reason they act as they do
- No employee buy-in
- Usually not consistent
- Injured people are punished by the injury AND further discipline
- People don't like to deliver it and don't like to receive it
- At best, only affects behavior when the boss is watching; at worst, not at all
- Is a negative approach to safety – supervisors are looking for people doing something wrong

Discipline produces:	Reward produces:
Minimal compliance	Extra effort
Bad feeling	Good feelings
Low morale	High morale

Only use discipline as a last resort when you determine that there is no underlying issue (training, equipment availability, process, etc.) that caused the unsafe action or inaction. Follow company policy and enforce the discipline.

Corrective, negative or judgmental comments make a heavy impact. Studies show that as many as five to seven positive remarks are needed to offset the sting of one negative comment. You want your employees to feel like they can approach you. You want to promote more effective interactions between you and your employees. Without effective feedback and worker involvement, behaviors are not likely to change. Supervisors want to increase the number of safe behaviors and eliminate at-risk behaviors. Ask *why* people act unsafely to determine underlying problems (training, equipment availability, processes, etc.).

Managing the Human Element in Safety

Managing the human element in safety simply means helping people perform their jobs more safely. It means better performance, higher morale and increased profitability for your company.

As a supervisor, you interact directly with employees, setting the tone for what does and what does not occur. Employees will look to your efforts to determine if the company cares about their safety. You provide a visible management commitment to safety. One way to maintain a good relationship with employees is for supervisors to accept ownership and not blame unpopular safety rules on upper management or the safety department.

Just as you are accountable for production or performance, you are accountable for the safety and well-being of your employees. Measure and reward safety activities that help to prevent incidents and injuries.

Shaping Safety Culture Through Safety Leadership

Integrate safety into business planning and decision-making, and challenge business decisions that may negatively impact safety now or in the future. Know how to manage operational hazards and intervene as necessary to uphold requirements.

Show your support by leading and actively participating in safety meetings, audits, incident investigations and incident investigation reviews, programs, and campaigns.

Act as a role model for reporting and addressing safety issues.

Create opportunities to talk with employees. Make sure that they know about potential hazards and your commitment to safety rules. Get to know their concerns and stay visible to stay informed about operational realities.

Steps to Improve Safety

- Clearly define and consistently enforce safety rules
- Set a good safety example
- Identify and correct physical and operational safety hazards
- Conduct accident and near miss investigations
    - Use the 5-Whys or another investigative approach to get to the root cause of the issue to prevent future problems
- Supply the necessary resources
    - Budget for maintenance
    - Buy necessary equipment and PPE
    - Allot time for safety meetings
- Conduct daily safety meetings
- Invest money in safety improvements
- Give employees a part to play in safety
    - Engage employees in safety efforts
    - Help them participate in safety improvements
    - Provide volunteer time for safety initiatives and safety committees
    - Ask for input on how to perform tasks safely

    - Ask for suggestions and follow up on their ideas
- Communicate regularly about safety
    - Talk one-on-one with employees about safety and discuss safety in regular work group meetings
    - Review safety and injury statistics
- Reinforce safe actions
    - Verbal praise works best
    - Deliver positive feedback (praise) five to seven times more frequently than constructive feedback
- Correct at-risk actions or inaction
    - Provide corrective feedback in a positive, helpful way
- Help all employees comply with safety rules and procedures
- Recognize that, when employees identify and correct safety hazards, the stage is set for safety success

How to Effectively Provide Corrective Feedback
Frequent and timely praise delivered when praiseworthy work is done is best.

To give supportive, positive feedback:
- Give praise directly to the employee as soon as possible after the behavior
- Identify specific safe behavior rather than using general statements
- Look for and praise:
    - Extra effort (more time and trouble to do the task safely)
    - Improvement
    - Consistently safe behavior

Regular at-risk behavior guarantees injuries will occur. The only way to prevent injuries is for everyone to work safely all the time. Provide feedback about at-risk behavior in a positive, constructive way that leaves your employee feeling helped, not criticized. To effectively provide feedback:
- Provide positive feedback one-on-one, praise publicly
- Focus on specific at-risk behavior, not attitude or personality
- Discuss, don't accuse or lecture
- If needed, teach how to do it safely
- Have the employee demonstrate the safe behavior, then give praise
- Ask for a commitment to do it the "safe way" next time
- Show your concern

Remain Positive
Feedback given constructively with intentions to be helpful may be met with defensiveness. Don't give in, but don't argue. If you can't think of a good response, walk away and plan how to handle it next time.

Keep your own emotions under control.

If your employer has a **safety director**, he or she will support your performance of these activities by training you, monitoring your performance, and so on. The supervisor is accountable for the activities listed above, NOT the safety director.

Examples of Ineffective and Effective Behaviors to Promote a Safety Culture

Ineffective Actions	Effective Actions
Harmful Actions… • Withholds information • Blames workers for problems • Reacts angrily without seeking solutions • Becomes defensive when issues arise	**Helpful Actions…** • Transparent and informative • Doesn't go back on his/her word • Works hard and is fair • Challenges unsafe conduct
Poor Communication… • Employees don't know how to voice safety concerns • Doesn't listen to ideas • Threatens retaliation or yells	**Good Communication…** • Visibly present in operating areas • Listens to hear what others are saying vs. listens to speak • Conducts daily safety huddles
Lack of Teamwork… • Says things like, "I'm in charge here and you'll do as I say." "You don't need to ask someone else for their opinion." "I'll tell you when something is risky." • Doesn't engage workers to be part of the safety solution • People are confused over their roles, resulting in inaction and lack of accountability	**Sense of Teamwork…** • Makes sure team members know each other and their relative roles • Highlights the importance of working together to improve safety • Asks for input on how to best carry out tasks safely
Poor Role Model… • Has others wear personal protective equipment (PPE), but doesn't consistently wear PPE • Thinks having weekly toolbox talks is all that's needed for safety	**Leads by Example…** • Provides needed safety resources • Follows safety rules • Never takes *or encourages* shortcuts

Personal Factors in Safety

Experience
Experience gives us an ADVANTAGE because it helps us make better decisions. It helps us spot subtle cues, makes us alert and cautious, and prepares us to react.

Never perform an unfamiliar task. Instead, become familiar first by:

- Discussing the task or asking for help
- Referring to procedures and manuals
- Developing a plan that accounts for what might go wrong and what must go right (pre-task planning)

Experience can also work to your DISADVANTAGE. Bad decisions don't always result in immediate safety incidents. As a result, people may miss improvement opportunities and form bad habits.

Eventually, bad habits lead to bad outcomes. Even if you are not getting hurt, if you sense there is a potential hazard, look for safer ways to work.

Judgment

- **Personal**. Be honest about your limitations. Pushing too hard to get work done can get you hurt. Set realistic plans and get help from others when you need it. You need to be mindful of the personal limitations and abilities of your co-workers too so that you will know who to ask for help and who you should be ready to help.
- **Equipment**. Understand and respect the limitations and capabilities of your equipment. Exceeding these limits can get you and others hurt. Take advantage of precautions like personal protective equipment (PPE) and machine safety devices for increased protection against incidental contact. Don't rely exclusively on these devices, because they can fail. Use them with good work practices to keep you away from danger.
- **Risk**. Danger may be greatest when people face a situation for the first time. Try to understand and remember risks. Then take appropriate actions. Becoming desensitized to risk can lead you to use work practices that seem safer than they really are.

Stress
We think and perform less effectively when we are stressed. Minor distractions can become major obstacles to our concentration and losing our focus can lead to bad decisions.
When we are stressed, we may:

- Become rigid and inflexible
- Repeat behaviors
- Break equipment (by trying to force it)
- Lose our concentration
- Miss warning signs (tunnel vision)
- Collide with or drop things
- Have jerky fine motor movements
- Tense our muscles (cause injuries)

Not every problem is within your control, so consider:

- Adopting a positive attitude
- Taking problems in stride
- Being positive
- Walking
- Stretching

Fatigue

Physical Fatigue

Physical fatigue can weaken us. Rushing to finish so that we can rest may lead us to:

- Make bad decisions
- Miss hazards
- Forget precautions
- Collide with things

Mental Fatigue

The causes of mental fatigue may include:

- Extended concentration on a detailed task
- Consuming alcohol or medications
- Having poor sleep habits
- Living an unhealthy lifestyle

The effects of mental fatigue may include:

- Loss of focus
- Dulled senses
- Slow reaction times
- Making mistakes
- Increased risk-taking
- Impaired judgment and decision-making
- Impaired communication skills
- Decreased attention span and inability to recall information
- Failure to anticipate events or actions

Emotional Fatigue

People experiencing emotional fatigue may display these symptoms:

- Quieter or more withdrawn than normal
- Lack of motivation to perform a task well
- Irritable or grumpy with co-workers, family or friends
- Heightened emotional sensitivity
- Low morale

Dealing with Fatigue

If you are mildly fatigued, slow down and allow more distance than usual so that you have extra time and space to react to hazards and obstacles. To prevent fatigue, try to get plenty of restful sleep and live a healthy lifestyle. Sleepiness and fatigue associated with sleep debt is cumulative. Sleep debt is when you sleep fewer hours than your body needs. Losing even an hour of sleep every other night over the course of a week will produce conditions that negatively affect performance.

Communication

Each team member contributes strengths. Ask for help and take it when offered. If you see someone struggling or being unsafe, say something. Be polite and show concern. We can develop bad habits we don't even know we have. It helps if someone tells us about bad habits.

Effective communication can be maximized when senders make a special effort to speak clearly, and receivers make a special effort to hear and understand – this is often referred to as "**active listening**."

When you give feedback:

- Send a clear message
- Set aside time for pre-job briefings, task handovers and other planned communication in a quiet place away from distractions
- Make it safe to ask questions
- Ask the receiver to confirm their understanding or restate important details
- Meet face-to-face whenever possible
- Be aware of communication difficulties when there are language differences
- Refrain from the use of jargon and technical terms

When you receive feedback:

- Actively listen
- Ask questions when you are not sure that you heard correctly
- Never assume anything
- Acknowledge and repeat what you heard
- Don't let the conversation end with unresolved ambiguities
- Reserve judgment and keep an open mind
- If a disagreement exists, take the most conservative action until more information is available

Assertiveness

Being assertive is about making sure your voice is heard, not about getting your own way. Being assertive means:

- Taking responsibility for yourself
- Be unafraid to ask for help and support when you need it
- Being able to say what you think and feel without losing your temper
- Knowing it's OK to say 'no'

If you sense potential danger or safety conditions change for the worse, step back and reassess the situation. If someone tells you to stop work, do so immediately. Exercise Stop Work Authority to pause work if you fear there's an imminent danger to people, equipment or the environment.

Fatigue Symptoms Checklist

Physical Symptoms	Mental Symptoms	Emotional Symptoms
☐ Yawning repeatedly ☐ Heavy eyelids or microsleeps ☐ Eye-rubbing ☐ Nodding off or head drooping ☐ Headaches, nausea or upset stomach ☐ Slowed reaction time ☐ Lack of energy, weakness or light-headedness	☐ Difficulty concentrating on tasks ☐ Lapses in attention ☐ Failure to communicate important information ☐ Failure to anticipate events or actions ☐ Making mistakes even on well-practiced tasks ☐ Forgetfulness ☐ Difficulty thinking clearly ☐ Poor decision-making	☐ More quiet or withdrawn than normal ☐ Lack of motivation to do a task well ☐ Irritable or grumpy with co-workers, family or friends ☐ Low morale ☐ Heightened emotional sensitivity

Egress and Emergency Action Plans

A **means of egress** is an unobstructed way of exit travel from any point in a building to a public way, street, walkway, refuge area or open space. It includes vertical and horizontal ways of travel such as doorways, hallways, stairs and scaffolds.

Components of an Exit Route

- **Exit access:** Portion of the means of egress that leads to an exit
- **Exit:** Portion of the means of egress that is generally separated from other areas by construction or equipment and provides a protected way of travel to the exit discharge. An exit route must be permanent
- **Exit discharge:** Portion of the means of egress between the termination of an exit and a public area

Fundamental Egress Requirements

Exits and other safeguards must be designed so that a person's safety *will not depend solely on any single safeguard*.

Building safeguards must include:

- An illuminated exit sign (so it can be seen if the lights in a building go out); illumination can be external, internal, or via photo luminescence
- Safety lights that turn on in the event of a power loss
- More than one exit (all with exit signs)

Egress Elements

1. **Clearly identified**
    - Every exit must be clearly visible and marked
    - Access to exits must be conspicuously and unmistakably identified
    - Doorways or passageways that do *not* lead outside must be arranged or marked to minimize their possible confusion with real exits
2. **Illuminated**
    - Adequate and reliable illumination shall be provided for all exit facilities: both exit access and exits
    - Every required sign designating an exit or way of exit access must be readily visible
    - Exit signs must meet the OSHA standard in size
    - No decorations, furnishings or equipment may impair visibility of an exit sign
    - No other distracting displays or signs may be put near or in the line of vision to a required exit sign

3. **Unobstructed and unblocked**
    - No lock or fastening may prevent free escape from the inside of any building
        - Exceptions include mental and correctional institutions
    - Free and unobstructed egress from all parts of the building must be available at all times when it is occupied
4. **Configuration**
    - When more than one exit is required from a story, at least two of them must be remote from each other
    - Doors leading to exits or exit access must be side-hinged and swinging
    - Such doors must swing WITH the flow of exit travel when the room is occupied by more than 50 persons, when the doors serve exit enclosures, or if the room is used for high-hazard content rooms
    - Exit access must not pass through a bathroom or other room subject to locking unless the exit is required to serve only the locked room
5. **Exterior considerations**
    - Access to an exit may be by means of any exterior roof, porch or balcony that conforms to the regulations
    - Exterior ways of exit access must have smooth, solid, substantially level floors and guards on the unenclosed sides
    - Areas subject to accumulations of snow or ice must be covered, unless they are the sole means of access and are regularly cleared of snow or ice
    - A permanent, unimpeded, reasonably straight path of travel must be maintained over the exterior way of exit access
    - All exits must discharge directly to the street or a yard, court or other open space that gives safe access to a public way, street, walkway, refuge area, or open space
    - Streets, yards, courts or other open spaces must be of adequate width and size
    - Stairs must be arranged to make the direction of egress to the street clear
    - Exit stairs that continue beyond the floor of discharge must "force" persons to make the right choice when presented with a right and wrong way to the street

Emergency Action Plans

An **emergency action plan** is a plan for a workplace describing procedures that employer and employees must take to ensure employee safety from fire or other emergencies.

Alarms

An **alarm** is a trigger that sets an emergency action plan into motion.

- Different signals are used for different situations
- Employers are required to establish an alarm system
- Employers must maintain and test alarms regularly

Information in Emergency Action Plans

At a minimum, your emergency plan must include:

1. Procedures for reporting a fire or other emergency (e.g., emergency phone number, manual pull stations)
2. Procedures for emergency evacuation
3. Procedures to be followed by employees who remain to perform critical operations before they evacuate

4. A plan for accounting for all employees after evacuation
5. Procedures to be followed by employees performing rescue and medical duties
6. The names and job titles of every employee who may be contacted by employees who need more information about the plan or an explanation of their duties under the plan

Employer Responsibilities

Employers must:

- Designate and train employees to assist in a safe and orderly evacuation of others
- Review the emergency action plan with each covered employee when the employee is initially assigned to a job as well as when the employee's responsibilities under the plan change
- Keep the written plan at the worksite, up-to-date and available to employees

Employers with 10 or fewer employees may communicate the plan orally and are not required to maintain a written plan.

Fire Extinguishers

If portable fire extinguishers are provided, they must be mounted and identified so workers can access them. Fire extinguishers must be:

- Maintained in a fully charged and operable condition
- Kept in their designated places at all times except during use
- Visually inspected monthly with the inspection recorded
- Inspected during annual maintenance checks

Record the annual fire extinguisher maintenance date and retain this record for one year after the last entry or the life of the shell, whichever is less.

Safety Signs

Purpose

Signs

- Safety signs provide important information to make safe decisions
- Signs need to be:
  - Visible
  - Legible
  - Placed in the proper area (e.g., before the hazard is reached)
  - Accompanied by appropriate controls

Hazards

- Signs provide visual cues and are a reminder about hazards and precautions
- Signs are NOT intended to replace guarding or other forms of hazard elimination and risk control
- In addition to signs, training and routine communication are other ways to communicate hazardous conditions and safety requirements

Report Missing Controls

- If you see a sign, look for safety controls nearby
- Safety controls are physical barriers or devices designed to keep you safe
  - Guardrails
  - Fences
  - Locks
  - Doors
- If you see something wrong, such as an open manhole with a safety sign but no guardrails, fix it if you can and notify a qualified person
- Safety is everyone's responsibility

Meaning

Signs can vary from site to site. However, some characteristics are the same. The color and signal words have the same meaning even if the size, shape and arrangement are different. Risk drives the signal word and color selection.

Colors and words

- Danger – red
  Contact with the hazard WILL CAUSE serious injury or even death
- Warning – orange
  Hazardous situations that COULD cause serious injury or death
- Caution – yellow
  Hazards nearby that could cause minor or moderate injuries (e.g., slippery when wet)
- Notice – blue
  Information about things to keep you safe (e.g., keep the area clear, wear personal protective equipment or wash your hands)
- Safety Instructions – green

General safety information (e.g., where to find a first aid kit, where to take shelter during a storm, or reminder to fasten your seatbelt)

Pictures

- Symbols describe hazards and precautions needed
- Examples

	Safety glasses required
	Dangerous voltage
	Pinching hazard
	Hearing protection required

Best Practices

- Signs provide safety reminders in the work area. You can also find safety information in:
  - company policies and procedures manual
  - bulletin board postings
  - standard operating procedures
  - safety training
- Ask if you are unsure about the meaning of a sign
- Report and address issues to qualified personnel
- Sign placement and size should be based on the distance to the hazard and how long it will take someone to react
- Some signs, such as exit signs, are illuminated for visibility during an emergency
- Signs should ALWAYS be supported by controls

Supervisor Supplement

Safety Sign Inspections

Periodically, walk through the work area and look at the safety signs. Make sure each sign is visible, legible, placed in the proper area and accompanied by appropriate controls.

Workplace Safety Sign Tour

When workers start a new job, either because they are new hires or their responsibilities are changing, take time to give them a brief safety sign tour of their work area. During the tour point out safety signs, explain the controls associated with the signs, and ask the workers if they have any questions about what the signs mean or what they need to do.

Follow-up Questions to Ask Workers

After workers take the *Safety Signs* course, stop by to ask them if they have any questions about specific signs in their work areas or if they have noticed any problems with those signs.

Remind workers to tell you if they see any problems, especially if signs are present without appropriate safety controls.

Worker Observation

After workers take the *Safety Signs* course, observe them to make sure they are noticing signs and acting accordingly. Remember to praise workers for doing a good job, not just point out when there is something wrong.

When you give feedback:

DO

- Explain your purpose (safety)
- Assume people don't know the risks
- Lead with the positive
- Be timely and specific
- Express concern
- Be personable
- Restate what they say to you
- Thank the person

DON'T

- Distract workers
- Assume they know what is wrong and how to fix it
- Make it personal
- Be vague/general
- Write while observing

Safety Signs: Know What They Mean

Personal Protective Equipment (PPE): Hazard Assessment

A hazard assessment is a process of identifying hazards, evaluating the risks presented by those hazards and managing the risks of the hazards. The hazard assessment will tell you about the hazard and what type of PPE you need. A hazard assessment must happen before PPE selection.

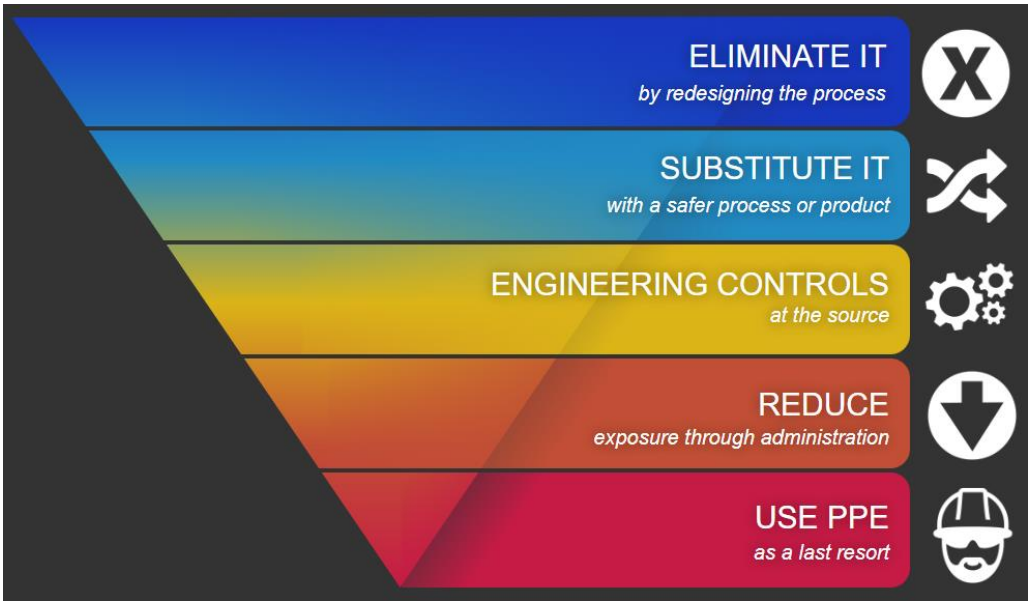
Types of Hazards and PPE
Common hazards include electric shock, sharp objects, falling objects, flying sparks, chemicals and noise. PPE used to protect against these hazards may include gloves, safety glasses, shoes, earplugs, hard hats, respirators, coveralls, vests and full-body suits.

Many people evaluate and prioritize risk with a risk matrix. See Appendix A below.

PPE and Other Controls
Engineering controls are structures or devices that physically protect workers from hazards or reduce workers' exposure to them. Common examples include machine guards, exhaust or wetting systems, and ergonomic workstations.

Administrative controls involve changing how and when workers do their jobs. Common examples include job rotation schedules or adding relief workers.

Always use PPE for activities as a supplement to other controls, not as the only control. PPE is the last barrier that protects you from hazards when other controls are not completely effective.



IMPORTANT: Be sure to look for safety signs, warnings and labels around your work area. These are important reminders about a hazard and the PPE requirements that will help keep you safe.

PPE Selection
Selecting the proper PPE should take into account a variety of factors including:

- Type of hazard present (e.g., electricity, sharp parts, noise or chemical exposure)
- Body part
- Route of potential harm to workers (e.g., electric shock or burn, inhalation, skin absorption, ingestion, injection, or eye or skin contact)
- Performance of the PPE materials, seams and construction in providing a barrier to these hazards

In hazardous waste operations and emergency response, there are four levels of protection that combine multiple pieces of PPE to create a level of protection based on the associated potential exposure.

- **Level A**: provides the greatest level of skin, respiratory and eye protection
- **Level B**: provides the highest level of respiratory protection but a lesser level of skin protection
- **Level C**: is used when the concentration and type of airborne substances are known and the criteria for using air-purifying respirators are met
- **Level D**: provides the minimum protection required

Check the manufacturer's label or marking on your PPE to make sure it will protect you from the potential hazard. If you feel that you aren't completely protected, stop work and talk to your supervisor.

Fit Test
PPE shouldn't move around or fall off while you work and shouldn't be too tight or constricting. To get a good fit:

- Choose a size that fits snugly but not too tight
- Adjust and secure any straps, fittings and headbands
- Check for a good seal when fitting respirators, goggles and hearing protection

PPE Inspection
If your PPE is worn out or damaged, it will not protect you when you need it. Inspect your PPE before and after each use. If it's unsafe to use, either permanently replace it or find a replacement while it's being repaired. Inform your supervisor and follow your employer's procedures to mark it "out of service." Some PPE, such as electrical gloves and respirators, require a written inspection/testing program.

Training Requirements
Employers must train workers who are required to wear personal protective equipment on how to do the following:

- Use protective equipment properly
- Know when PPE is necessary
- Know what kind of PPE is necessary
- Understand the limitations of PPE in protecting workers from injury
- Put on, adjust, wear, and take off PPE
- Maintain protective equipment properly including any required testing and recertification

Appendix A

Evaluating and Prioritizing with a Risk Matrix

Many people use a risk matrix to assess risk. The following is a sample risk matrix.

			Likelihood				
			Rare The event may occur in exceptional circumstances.	**Unlikely** The event could occur at some time.	**Moderate** The event will probably occur at some time.	**Likely** The event will occur in most circumstances.	**Certain** The event is expected to occur in all circumstances.
			Less than once in 2 years	At least once per year	At least once in 6 months	At least once per month	At least once per week
		Level	**1**	**2**	**3**	**4**	**5**
Consequence	**Negligible** No injuries. Low financial loss.	**0**	0	0	0	0	0
	Minor First-aid treatment. Moderate financial loss.	**1**	1	2	3	4	5
	Serious Medical treatment required. High financial loss. Moderate environmental implications. Moderate loss of reputation. Moderate business interruption.	**2**	2	4	6	8	10
	Major Excessive, multiple long-term injuries. Major financial loss. High environmental implications. Major loss of reputation. Major business interruption.	**3**	3	6	9	12	15
	Fatality Single death.	**4**	4	8	12	16	20
	Multiple fatalities Multiple deaths and serious long-term injuries.	**5**	5	10	15	20	25

Risk Rating	Risk Priority	Description
0	N	**No Risk:** The costs to treat the risk are disproportionately high compared to the negligible consequences.
1 – 3	L	**Low Risk:** May require consideration in any future changes to the work area or processes or can be fixed immediately.
4 – 6	M	**Moderate:** May require corrective action through planning and budgeting process.
8 – 12	H	**High:** Requires immediate corrective action.
15 – 25	E	**Extreme:** Requires immediate prohibition of the work process and immediate corrective action.

Hearing Conservation

Most occupational hearing damage happens gradually due to exposure to high noise levels over time. The good news is that you CAN prevent hearing loss.

Noise and Hearing
Loud noises, as well as noise over time, can damage your ability to hear.

- A short-term (acute) exposure to moderate noise could result in a temporary loss of hearing *(Temporary Threshold Shift)*
- A short, intense sound, such as an explosion, may cause immediate hearing loss, which can be permanent *(Acoustic Trauma)*
- Most hearing loss, however, happens gradually upon exposure to high noise levels over a period of time *(Permanent Threshold Shift)*

Signs of Hearing Loss
Because hearing loss typically appears gradually over time, you may not even realize that you are losing your ability to hear. You may notice that:

- Sounds become muffled or distorted
- Conversations become more difficult to understand
- You have trouble hearing in noisy areas
- You experience ringing, hissing or pulsing in your ears

Hearing Conservation Program
The Occupational Safety and Health Administration (OSHA) requires your employer to administer a hearing conservation program whenever employee noise exposures equal or exceed an 8-hour time-weighted average sound level of **85 decibels**.

Monitoring Noise Levels

- Your employer will monitor noise exposure levels to identify employees who are exposed to noise at or above 85 decibels averaged over 8 working hours
- Your employer will repeat monitoring whenever changes in production, process or controls have the potential to increase exposure to noise

Conducting Hearing Tests

- Affected employees will take an initial baseline hearing test and annual hearing tests thereafter
    - Your employer must provide these audiometric tests at no cost to you
- Your baseline test shows what your normal hearing is, and is used as a reference for future tests to determine whether loss of hearing is occurring

Complying with Recordkeeping Requirements

- Your employer will:
  - Keep noise exposure records for at least 2 years
  - Maintain records of your hearing test results for the duration of your employment

Offering Annual Training

- Your employer must train you annually on:
  - The effects of noise on hearing
  - The purpose of audiometric testing, with an explanation of the test procedures
  - The purpose of hearing protection

Providing Hearing Protection

- Your employer may be able to reduce worker exposure to hazardous noise by changing equipment and work schedules
- If your employer cannot reduce or eliminate the level of hazardous noise, hearing protection (such as earplugs or earmuffs) must be worn

Types of Hearing Protection

Type	Advantages	Disadvantages
Single-Use Earplugs	• Convenient to use, even with other hearing protection • Inexpensive and disposable • Comfortable for long-term use in hot environments	• Require more time to put in • More difficult to insert and seat correctly • Are easily lost or misplaced • Require clean hands to handle and roll • Can cause ear infections when unclean
Pre-molded Earplugs	• Washable and reusable • Easy to insert properly • Don't require the user to handle the tips	• Are easily lost or misplaced • Can cause ear infections when unclean • Require trial and error to find a plug that fits • Custom-molded earplugs are expensive
Canal Caps	• Convenient and simple • When it is quiet, you can leave the band hanging around your neck	• Not all canal caps have tips that adequately block all types of noise • Some people find the pressure from the band uncomfortable

Earmuffs	• Come in many models and provide different levels of protection
	• The variety of styles makes it easy to find a comfortable pair
	• Easier to slip on and off than earplugs
		• Require a good seal
		  ○ Long hair, eyeglasses and safety glasses may make it difficult to get a good seal
		  ○ Facial movements such as chewing may reduce the protective value
		• Can be uncomfortable in hot environments

Inserting Earplugs

To insert a single-use earplug:

1. Roll the plug into a thin, smooth tube using both your thumb and fingers or by rolling it across your palms.
2. It should be thin enough to allow half of its length to fit easily into your ear canal.
3. Insert it by reaching over your head with one hand to pull up on the top of your ear.
4. Then use your other hand to insert the plug with a gentle rocking motion until you have sealed the ear canal.
5. It's generally advisable to maintain light pressure on foam plugs while they expand to ear canal contours. Otherwise they may move out of position before a good seal is formed.

To insert a pre-molded earplug:

1. Reach over your head with one hand to pull up on the top of your ear.
2. Then use your other hand to insert the plug with a gentle rocking motion until you have sealed the ear canal.
3. Because directions for fitting each model of pre-molded plugs may differ slightly, consult the manufacturer's directions.

Use and Care of Hearing Protection

<table>
<tr><th>Type</th><th>Pre-Use Inspection</th><th>Cleaning</th></tr>
<tr><td>Single-Use Earplugs</td><td rowspan="3">• Check for dirt, damage or extreme hardness
• Check pre-molded earplugs for deterioration and discard if cracked or not forming a good seal</td><td>• Discard after every use</td></tr>
<tr><td>Pre-molded Earplugs</td><td rowspan="3">• Clean after each use
○ Wipe down with mild soap and warm water, and gently pat dry
○ Do not submerge earmuffs in water
○ Do not treat with any other substances
○ Keep hearing protection inside a case between uses</td></tr>
<tr><td>Canal Caps</td></tr>
<tr><td>Earmuffs</td><td>• Check for cracks and leaks in the earcups or cushions
○ Replace damaged cushions
○ Discard earcups if damaged
○ Discard earmuffs when the headband no longer holds the cups tightly against the ear</td></tr>
</table>

Respiratory Protection

Proper respirator use protects employees from harmful dusts, fogs, fumes, mists, gases, smokes, sprays or vapors. If your workplace contains hazardous atmospheres, you need to know when and how to wear a respirator.

Employer Responsibilities
- Identify and evaluate respiratory hazards
- Attempt to eliminate or reduce hazards using engineering controls
- Select and provide appropriate respirators when engineering controls are not possible
- Establish and implement a written respiratory protection program with worksite-specific procedures
- Identify and train a competent administrator to manage the program
- Ensure the proper use and fit of appropriate respirators
- Provide training and retraining for those who wear respirators

Your Responsibilities
- Always use an appropriate respirator in potentially hazardous environments
- Refer to a chemical's Safety Data Sheet (SDS) for the type of respiratory protection you need to use
- Follow proper procedures and safe work practices when wearing a respirator

Prerequisites

Medical Evaluation
- Medical evaluations are a way to determine your ability to SAFELY use a respirator
- Employees should disclose any known medical conditions to the healthcare professional that administers the evaluation

Fit Testing
- The proper fit of a respirator is essential to its effectiveness
- Workers should be fit tested with the same make, model, style and size of respirator they will use
- Fit test before using the respirator
- Safety standards typically require retesting on a set schedule (e.g., annually)
- You must ensure that the protective seal is intact and that the respirator is the right size for your face and fits securely and snugly
- Facial hair, glasses and PPE may interfere with the seal
- Fit testing typically involves test exercises and re-donnings of the respirator. Three test exercises are: normal breathing, bending over and head shaking

Types of Respirators

There are a variety of respirator types, and each has certain capabilities and limitations. Knowing these limitations will help you select the appropriate respirator.

Disposable Dust Respirators
- Designed to protect lungs from low concentrations of dust, mists, pollen and animal dander

- Lightweight, relatively comfortable and inexpensive
- Do not protect against chemicals, gases vapors and oxygen-deficient atmospheres

Air-Purifying Respirators (APRs)
- Have filters, cartridges or canisters that remove contaminants from the air by passing the ambient air through the air-purifying element
- Can be either full-face or half-masks with mechanical or chemical cartridges
- Small, light and simple in operation
- Time period over which protection is provided depends on the canister, cartridge or filter type; concentration of contaminant; humidity levels in the ambient atmosphere; and user's respiratory rate
- Limited to conditions where exposures can be measured so that the user can be sure the respirator will be effective
- Do not supply oxygen; therefore, must not be used in oxygen-deficient atmospheres

Self-Contained Breathing Apparatus (SCBA) Respirators
- Provide clean air from a high-pressure cylinder carried on the user's back
- Offer maximum protection from airborne contaminants
- Weight, bulk and limited service (no more than 40 minutes of air) are factors to consider
- Require additional training for maintenance and use

Air-line Respirators
- Provide clean, fresh air from a stationary source
- May be equipped with a half or full facepiece, helmet or hood
- May be used for long periods of time and provide a high degree of protection
- Provide no protection if air supply fails; may only be used when the wearer would be able to escape unharmed from the atmosphere without the aid of the respirator
- Drawback: Hose restricts movement and can be punctured or pinched off

Staying Safe
IDLH (Immediately Dangerous to Life or Health) Atmospheres
- These atmospheres can put your life at immediate risk, irreversibly damage your health or make it difficult to escape
- All toxic and oxygen-deficient atmospheres are considered IDLH
- Employees need specific training for IDLH atmospheres
- Only employees with approved atmosphere-supplying respirators may enter these atmospheres
- At least one employee who is trained and equipped to provide emergency rescue must be located outside the IDLH atmosphere

Respirator Failure
While wearing a respirator in a hazardous atmosphere, pay attention to possible signs of respirator failure, such as changes in breathing resistance or leakage of the facepiece.

Exit the area immediately and go to a safe place to remove your respirator if you experience:
- An odor or taste

- Eye or throat irritation
- Any discomfort such as nausea, dizziness or weakness

Inspection and Maintenance

Inspection

- All respirators, including respirators maintained for use in emergency situations, should be inspected before each use and during cleaning
- Evaluate respirator's tightness of connections and condition of the various parts
- Make sure rubber parts are pliable and show no signs of deterioration
- Respirators that fail an inspection, or are otherwise found to be defective, must be removed from service and then discarded or repaired. Only trained personnel may repair respirators

Cleaning and Storage

- Clean your respirator as often as necessary to maintain its sanitary condition
- When not in use, respirators should be stored to prevent excessive exposure to dust, sunlight, extreme temperatures, excessive moisture or damaging chemicals
- Plastic containers with lids provide adequate storage for respirators
- Refer to the manufacturer's instructions for help or ask your supervisor

Hexavalent Chromium

What Is It?
Hexavalent chromium, also called hex chrome, chrome six or CrVI, does not occur naturally. It is generated through industrial processes and hot work activities. It exists in a few different forms:

Chromate pigments	Dyes Paints Inks Plastics
Chromate added as anti-corrosive agents	Paints Primers Other surface coatings
Chromic acid	Electroplating that adds protective and decorative coatings

Chromium becomes hexavalent chromium only when exposed to high temperatures. This may occur during hot work including:

- Working on industrial materials
- Chroming operations
- Melting down chromium metal

Doing any hot work, such as welding, on a material containing chromium will cause the chromium to become hexavalent chromium.

Who Is Affected?
There are three types of workers who have an increased risk of exposure:

- Hot work workers (welding, cutting, grinding, brazing)
- Chroming workers
- Painters

There are also other groups that have a lesser degree of risk than the top three.

Health Hazards
Hexavalent chromium is a known carcinogen. There are some serious potential health hazards associated with exposure to hexavalent chromium. Recognizing these symptoms early can alert you to an overexposure.

- **Eyes:** If chromic acids or chromate dusts have direct contact with your eyes, they can cause a burning irritation or permanent eye damage.
- **Respiratory tract:** Exposure to hexavalent chromium can irritate your nose, throat and lungs. Prolonged or repeated exposure can severely damage the mucous membranes in your nasal passages and result in ulcers or perforation of the septum.

- **Skin:** Prolonged exposure to hexavalent chromium can result in skin ulcers and dermatitis.
- **Lungs:** Hexavalent chromium can cause lung cancer.

Hexavalent chromium can **enter your body** in three ways:
- Inhalation (breathing airborne dust, fumes or mist)
- Ingestion (via contaminated food, drinks and cosmetics)
- Absorption (through skin)

Family members are also susceptible to hexavalent chromium exposure from contaminated clothing and other items brought home by employees.

Resources
Refer to your employer's hazard communication program to determine if you are exposed to hexavalent chromium in your workplace.

Refer to the manufacturer's Safety Data Sheet (SDS) to learn more about:
- The particular hazard
- The proper ways to protect yourself
- First aid procedures in the event of exposure

On SDSs, hexavalent chromium will often appear as chromate.

Controls
Engineering Controls
Engineering controls include:
- Substitution (e.g., using a less toxic material or process that results in lower exposure)
- Isolation (e.g., enclosing the source of exposure)
- Ventilation (e.g., using a local exhaust system that captures airborne hex chrome near its source)

Employers must ensure good **ventilation** of fumes by:
- Using local exhaust ventilation
- Making sure air is not re-circulated or discarded (per environmental regulations)
- Using capture velocities of less than 1 meter per second, or 200 feet per minute, so shielding gas is not affected (if applicable)
- NOT opening windows or doors or using cooling fans
- Regularly cleaning and maintaining local exhaust ventilation (LEV) systems

Work Practice and Administrative Controls
Employers must also:
- Establish a regulated area whenever an employee's exposure to airborne concentrations of hexavalent chromium is, or can reasonably be expected to be, in excess of the permissible exposure limit (PEL)
- Ensure that regulated areas are identified (e.g., warning signs, gates, ropes, barricades, lines, textured flooring)
- Limit access to regulated areas

- Authorize all work and employees in regulated areas

Cleaning
Your employer must ensure that all surfaces are maintained as free as possible of accumulations of hexavalent chromium.

Surfaces contaminated with hexavalent chromium must be cleaned by high-efficiency particulate air (HEPA)-filtered vacuuming or other methods that minimize exposure, including wet methods such as wet sweeping or wet scrubbing.

Dry shoveling, dry sweeping and dry brushing may be used only where HEPA-filtered vacuuming or other methods that minimize the likelihood of exposure to hexavalent chromium have been tried and found to be ineffective.

Do not use compressed air to remove hexavalent chromium from any surface unless:
- The compressed air is used in conjunction with a ventilation system designed to capture the dust cloud created by the compressed air
- No alternative method is feasible

To protect yourself from hexavalent chromium exposure:
- Wash your hands at the end of your work shift and before eating, drinking, smoking, or applying lip balm or cosmetics
- Wear outer garments to avoid contaminating primary clothing
- Avoid bringing contaminated clothing or other articles home
- If bathing facilities are present, shower before leaving work
- Never eat, drink, smoke or vape in areas where hexavalent chromium is present

Personal Protective Equipment (PPE)
The PPE you need to use is determined by your employer.

If respirators are required:
- The type will depend on workplace conditions and contaminant levels
- They can only be worn by authorized, trained and medically qualified personnel

Typical PPE includes:
- Heat-resistant PPE approved for welding (coveralls, welding shield, leather gloves, welding apron/coat)
- Splash-proof goggles
- Face shields
- Chemical-resistant gloves
- Aprons
- Protective footwear

Make sure you are aware of the requirements and follow your employer's PPE program. If you have any questions, contact your supervisor.

Additional Requirements
Employers must

- Have a written plan for hexavalent chromium operations
- Make an initial exposure determination and communicate the exposure risks to employees
- Prepare and update a written plan describing the specific control steps being taken to reduce employee exposure to or below the PEL

Each employee engaged in hexavalent chromium operations must be provided documented training relating to the hazards and precautions for its safe use.

Employers are also required to have a medical surveillance program as well as a respiratory protection program.

Medical Surveillance
In the U.S. and various other regions, medical surveillance must be provided to employees who are exposed to hexavalent chromium at or above the action level for 30 or more days a year.

Medical examinations must be provided within 30 days after initial assignment to a job involving hexavalent chromium exposure, unless the employee has received an examination that meets the requirements of the standard within the last 12 months.

The written medical opinion must be obtained within 30 days of the examination and must contain the medical professional's opinion as to whether the employee has any detected medical condition that would increase risk.

Emergencies
In the event of an emergency or uncontrolled release of hexavalent chromium, immediately utilize an eyewash station and/or shower and be sure to wash your hands to remove metals. Notify your supervisor and seek medical treatment within 30 days after exposure during an emergency or uncontrolled release.

In the U.S., workers must be seen by a physician or other licensed healthcare professional (PLHCP), and an opinion must be provided within 30 days. Other countries have similar requirements.

Lead Poisoning

Lead is a highly toxic metal. Many alternatives to lead have been identified, but it is still used in some industries. To stay safe and healthy, we must limit and monitor exposure to lead.

Sources
Lead is a naturally occurring, bluish-gray metal in the Earth's crust. People may inhale lead dust or fumes in the air or ingest it when they touch lead and then consume food or drinks. Lead may be pure, or it may combine with other elements to form compounds. Pure lead does not dissolve in water, but some lead compounds can dissolve.

Sources of lead may include:
- Batteries
- Metal products
- Paint
- Ammunition
- Cable covering
- Gasoline/petroleum
- Burning solid waste/coal/oils
- Emissions from iron/steel production
- Lead smelters

Health Effects
Your body can absorb lead when you inhale it in the air, ingest it due to contaminated items/hands or expose open wounds to it. The health effects of lead are the same no matter how it enters your body. However, the body absorbs lead most easily when people breathe it in. Lead may reach various organs and body tissues through the bloodstream. Your body will store any lead it can't get rid of in your teeth, bones, organs and tissues where it can cause irreversible damage to cells, organs and whole-body systems. Stored lead continues to cause damage even after the initial exposure.

Early symptoms of lead exposure may include:
- Nausea
- Headaches
- Sluggishness
- Vomiting
- Gastrointestinal irritation and pain
- Diarrhea
- Loss of appetite
- Colic (abdominal pain)
- Weakness
- Dehydration

Because these are common conditions, people may not realize they are due to lead poisoning.

Long-term effects of lead include:
- Anemia

- High blood pressure
- Heart, kidney and brain damage
- Seizures
- Cancer
- Infertility
- Coma
- Death

If you are pregnant, lead can harm your baby. It can cause neurological effects and disabilities in babies or cause the mother to experience miscarriage or stillbirth.

Safety Measures
Your employer will determine when lead exposure is a concern and will then **monitor** your exposure to lead using testing devices such as air sampling, surface wipes and portable x-rays on surfaces. They must make sure lead doesn't exceed occupational exposure limits set by industry standards and your government to protect your health and wellbeing.

Employers must **record all monitoring results** and make them available to employees. Ask your supervisor if you have any questions or concerns about the monitoring and recordkeeping processes.

Ventilation systems may remove lead from the air or dilute it to safe levels.

Check with your supervisor to learn the specific lead exposure hazards in your workplace. Look for and respect **signs** that warn about lead and precautions to take.

Keep all surfaces **as free as possible from accumulated lead dust**. Vacuum with a high efficiency particulate (HEPA) filter. Do NOT use compressed air to clean floors and other surfaces.

When lead is in the air, it may settle on your clothes and body. If you don't **clean**, everywhere you go becomes contaminated too. If you eat, drink, apply cosmetics or use tobacco with lead on your hands or face, you risk ingesting it.

Your employer must provide you with free **protective clothing and equipment** in areas that exceed the occupational exposure limit for lead. This includes:
- Coveralls or full-body work clothing
- Gloves
- Hats
- Shoes or disposable shoe covers
- Face shields
- Vented goggles
- Respirators

Your employer will provide you with training and fit testing, as needed.

When lead levels exceed the occupational exposure limit, use a **designated change room** to:
1. Carefully remove contaminated clothing.

2. Place it in labeled containers and close them.
3. Shower.

Your employer provides **designated break areas** that have filtered air. This is the only place you may consume food or drinks or use cosmetics or tobacco products.

Overexposure
Immediately notify your employer if you:

- Develop signs or symptoms of overexposure
- Want medical advice concerning a current/past exposure

Your employer will provide you with appropriate medical examinations or consultations.

If you have been exposed to lead above the occupational exposure limit, your employer may be required to provide you with medical surveillance that includes an exam by a physician and a blood test.

Check with your supervisor or government to learn about your rights and your employer's responsibilities regarding potential exposure to lead.

When you have been overexposed to lead, your employer may be required to reassign you to a job that has low or no lead exposure.

The reassignment should not result in any loss of earnings, seniority or other employment rights or benefits.

You may not be reinstated to work around lead unless or until your blood tests reveal that the lead is no longer present at unsafe levels.

REMEMBER: Check with your supervisor or government to learn about your rights and your employer's responsibilities regarding potential exposure to lead.

Dust Mask – Voluntary Use Guidelines

For serious hazards, workers are REQUIRED to wear respirators for protection. This job aid focuses on good practices for the VOLUNTARY use of disposable dust masks and filtering facepiece respirators (FFRs).

Types of Respirators
A respirator is a device that protects you from inhaling airborne substances such as dust, vapors, gases and fumes. Respirators offer varying levels of protection, so it's important that you can tell the difference between the types and understand how each works.

Atmosphere-Supplying Respirators
Atmosphere-supplying respirators supply breathable air directly to the user from a source other than the hazardous atmosphere.

Because these respirators provide their own air, they don't have filters.

- Self-contained breathing apparatuses (SCBAs) use their own air tank to supply clean air and are used in toxic and oxygen-deficient atmospheres
- Air-line respirators provide clean, fresh air to the user from a stationary source, such as a compressor or compressed air cylinder

Air-Purifying Respirators (APRs)
Air-purifying respirators (APRs) have filters or cartridges that remove contaminants from the air as they pass through the air-purifying element before reaching the user. They can be full-face or half-masks with mechanical or chemical cartridges.

APRs do NOT protect against oxygen-deficient atmospheres because their canisters or cartridges do not provide clean air. APRs must not be selected for atmospheres that are toxic and immediately dangerous to your life or health. **Filtering facepiece respirators and dust masks are types of APRs.**

Filtering Facepiece Respirators (FFR)
A filtering facepiece respirator (FFR) is a particulate respirator that cleans particles out of the air as you breathe. While these are the most common respirators, they are also the least protective. They would be dangerous if used in situations that require more substantial masks.

A dust mask is a type of filtering facepiece respirator. The terms "dust mask" and "filtering facepiece respirator" are often used interchangeably

Filtering facepiece respirators:

- Have a filter as the main part of the facepiece
- Are designed and tested to meet standards, such as those set by the National Institute for Occupational Safety and Health (NIOSH)
- Are marked with a rating such as KN95 or N95
- Have two loops for attaching to the face – one above the ear and one below

Dust masks:

- May not be certified by a testing agency
- May be voluntarily worn for comfort against non-toxic, nuisance dust
- Often have one ear loop only
- Should not be relied upon for health and safety protection

Filtering facepiece respirators are classified by their:

- Efficiency at stopping small particles, from lowest to highest – 95, 99 or 100
- Level of resistance to the effects of oil – not resistant (N), resistant (R) or oil-proof (P)

For example, an N95 mask has the lowest level of efficiency and is most affected by the presence of oil mists. It is commonly available for voluntary use. Look for the mask's efficiency and oil resistance ratings and suggested use on the packaging. Look for the testing agency's logo or name on the mask itself or on the straps.

Surgical masks, medical masks, procedure masks and other face coverings usually do not prevent leakage around the edge of the mask when the user inhales. These masks are usually just intended to prevent the release of potential contaminants FROM THE USER into their immediate environment.

Selecting a Mask

If the use of respiratory protection is mandatory, your employer will have a qualified person select the appropriate type of protection you need.

FFRs may be **mandatory** when working around elevated levels of lead dust or silica dust. You might **voluntarily** wear a mask around nuisance dust during activities that produce nonhazardous dust like sanding, mowing or sweeping, or when you feel discomfort from low levels of pollen and other mild allergens.

To ensure that an FFR does not present a hazard:

- Read and follow all instructions provided by the manufacturer
- Be sure it bears a mark verifying it has been tested and meets PPE standards
- Don't wear an FFR in atmospheres it's not designed for; FFRs are for dust, not for gases, vapors, fumes or smoke
- Keep track of your FFR so that you only use yours

Usage Guidelines

Some general guidelines for using a filtering facepiece respirator include:

- Your employer needs to ensure that masks are not dirty or contaminated and that their use does not interfere with the ability to work safely
- Limit the use of filtering facepiece dust mask respirators to 8 hours (continuous or intermittent)
- Try different brands, models and sizes to get a comfortable fit
- People with pre-existing pulmonary or cardiovascular issues may have trouble wearing masks that restrict breathing. Discontinue use and notify others if you experience dizziness or difficulty breathing
- Follow the manufacturer's instructions:

- Use ear loops correctly
- Use both head straps for FFRs, making sure they are correctly positioned and adjusted
- Make sure the facepiece is snug
- Mold the nosepiece to your face

Care Guidelines
Store respirators where they're protected from damage, contamination, dust, sunlight, extreme temperatures, excessive moisture and damaging chemicals. **Inspect** respirators before use to ensure they are clean and have all parts. A filtering facepiece respirator should have two elastic straps, a moldable nosepiece and, if equipped, a functioning exhalation valve.

Discard respirators if they are or become soiled, contaminated or damaged or don't allow you to breathe freely.

Bench Grinder Safety

Common Causes of Injury
Bench and pedestal grinders are powerful tools that require precision and precaution. A jagged wheel fragment can fly fast enough to penetrate the soft tissue of your neck, eyes and face.

In addition to projectiles from wheel breakage, other common hazards are:

- Contact with the wheel
- Burns and fires from sparks and hot parts
- Flying chips, debris and parts of the grinding wheel
- Exposure to loud noise and grinding dust
- Slippery floors from grinding dust and particles
- Entanglement in rotating equipment

Safety Features of a Bench Grinder

- The **tongue guard** (spark guard) is adjustable and helps contain sparks and particles thrown from the wheel. This guard plays an important role in containing shrapnel from wheel breakage
- The **flange** is designed to grip the grinding wheel more securely and distribute contact stresses applied during tightening – stresses on the side of the wheel that can damage or break it
- The **spindle guard** (side guard) covers the side surfaces of the wheel and protects the operator from abrasions, entanglement and thrown particles in the event of wheel failure. It also protects against inadvertent contact with the wheel sides, which can lead to wheel breakage
- The **eye shield** provides another layer of protection against thrown particles. Some grinders don't have this feature, but when present it must be maintained.
- The **work rest** (tool rest) helps steady the workpiece. The work rest is adjustable to maintain a narrow gap, or nip area. The larger the gap, the greater the risk of materials becoming jammed between the rest and the wheel, and the greater the risk of serious hand injuries and wheel breakage

General Precautions and Safe Use
Some general precautions you can take for your safety include:

- Inspecting the grinder before each use
- Not wearing anything that may get caught in moving parts, such as loose clothing, neckties and jewelry
- Containing long hair
- Avoiding reaching past the wheel
- Never leaving the grinder running unattended
- Keeping the work area clean
- Wearing eye and face protection at all times (safety glasses with side shields and face shield) and body, foot and hearing protection as required
- Working in well-ventilated areas with approved safety equipment, including respiratory protection as required
- Using locking pliers, tongs or another method for holding the work

Gloves should be worn with caution. The spinning wheel could grab a glove and pull your hand into the grinder. If worn, they must be tight fitting. Follow your employer's policy.

Tips for Safe Use

- Ensure the grinder is mounted on a solid bench or pedestal and securely bolted to a rigid mounting surface

- Unplug the grinder when changing the wheel or adjusting the guards, and make sure that the switch is in the "off" position before plugging in the grinder
- Grind only on the grinding face of the wheel to prevent weakening or breaking the wheel or injury
- Whenever possible, use the work rest to support the workpiece during the grinding operation. Turn the grinder off if it jams
- Gradually increase the feed rate as the wheel comes to speed and warms up. Never force the workpiece into the grinder

Wheel Maintenance, Selection and Testing

- Dress (trim) the wheel face periodically
- Never grind soft metals like aluminum
- Replace cracked and chipped wheels IMMEDIATELY
- Worn wheels MUST be replaced when guards will not adjust inward enough to maintain required tolerances
- When replacing a worn wheel, remove grinding dust from the wheel guard area. Wear gloves to protect your hands from hot or sharp pieces that may be present as a result of normal use
- Choose a grinding wheel of a suitable size and speed for the grinder, as indicated by the grinder's data plate and wheel markings, and the dimensions listed in the owner/operator manual
- Conduct a ring test by suspending the wheel on a string or on the shank of a screwdriver, tapping the outer edge with a non-metallic object, and listening for a "ring"
    - Rotate the wheel 45 degrees and repeat the test
    - Discard any wheel that doesn't "ring" as it probably has an internal defect
- Store wheels vertically and in a rack to avoid damage

Wheel Replacement

Follow these steps ONLY AFTER REMOVING THE POWER:

1. Tighten the spindle nut just enough to prevent the wheel from slipping, but not so much that the wheel is damaged from the stress.
    a. Reattach the side guard so that it covers the spindle, flange, nut and at least 75% of the grinding wheel periphery
2. Readjust the tongue guard and work rest clearance to the MINIMUM clearance of 1.6 millimeters (1/16 inch).
3. Position the eye shield so that it is in the line of sight to the work rest.
4. Turn the wheel by hand, making sure it is clear of obstructions and that it turns freely.
5. Remove adjusting tools, check that the controls are switched off, and restore power.
6. Stand to the side for a minute of rotation at full speed. If the grinder doesn't come up to speed smoothly and without vibration, shut it off immediately and determine the reason.

Machine Guarding Part 1: Hazards

Machines can be dangerous when they aren't guarded. Before you can protect yourself, you must first understand what the dangers are.

Machines may have hazards including:

- Motion
- Chemicals
- Dust and particles
- Light
- Noise
- Vibration
- Pressure
- Electricity
- Extreme temperatures

ALL hazards require your attention, but the focus of this job aid is the physical hazards presented by machine motion.

There are two specific areas where you should expect machine motion hazards:

- Point-of-operation or danger area (where machines perform work)
- Power train or transmission

Hazards associated with machine motion may include:

- **Nip and pinch points**. Nip and pinch point hazards occur where rotating machine parts contact other surfaces or parts.
- **Entanglement hazards**. Rotating parts can grab, snag and entangle body parts, hair, and loose clothing or items, pulling you into moving machine parts and causing broken bones, amputations and other serious injuries.
- **Shearing and crushing hazards**. Back-and-forth, sliding, reciprocating or traversing motions are shearing and crushing hazards.
- **Machining, breakage and projectiles**. The normal operation of machines may produce flying dust and cuttings. When machines, machine parts and materials break violently, they may become high-velocity projectile and impact hazards.

You can identify hazards around machines by using:

- **Warnings and signs**. Manufacturer decals, employer warning signs and high visibility paint help you identify and avoid hazards. Pay attention to colors, symbols, pictograms and warning statements and ask your supervisor if you have questions. We must maintain these warnings to keep everyone safe.
- **Training**. Your employer will train you about your workplace, its machines and specific hazards and safeguards. Machine manuals and procedures, lockout/tagout procedures and job hazard analysis forms also contain valuable safety information.
- **Senses, observations, inspections and reports**. Pay attention to your own senses and observations. Heat, vibration, intense sound, light and even the smells of machine operation can be clues that indicate that hazards are present. Use your employer's process to document inspections and report concerns, close calls, incidents, and missing or damaged guards.

Machine Guarding Part 2: Precautions

Unguarded machines can amputate fingers, hands, entire limbs and even kill. Safety regulations require machine guarding. You can avoid injuries and penalties by installing, using and maintaining machine guarding and following safe work practices.

NOTE: ALL hazards require your attention, but the focus of this job aid is the physical hazards presented by machine motion.

What Are Machine Guards?
A machine guard is a physical barrier that prevents people from being exposed to machine hazards. Machine guards do NOT eliminate hazards.

The closer people are to the hazard, the smaller the guard opening must be.

Where people feed materials into the machine by hand, the guards on feeders must separate workers from the point-of-operation, or danger area, where machines perform work.

Machine guards must:

- Protect people from contacting machine hazards
- Be sturdy enough for regular use and machine malfunctions
- Allow people to maintain and adjust them

Types of Machine Guards
Sometimes, manufacturer-installed guarding is sufficient. Other times, employers need additional guarding to protect workers. Employers perform machine risk assessments and choose supplemental safeguards to reduce risk and enhance production. If possible, the original equipment manufacturer should review and approve the safeguard design. Once safeguards are in place and anytime processes change or there is a safety incident, employers will reassess the risk and make changes, as needed.

Fixed Guards
A fixed guard is a part of the machine that encloses or makes dangerous machine parts unreachable. A fixed guard is not dependent upon moving parts to perform its intended function. It should require special tools for removal and is not designed for easy or frequent access to the parts beyond it. A fixed guard is usually preferable to all other types because its simplicity.

Interlocking Guards
An interlocking guard shuts off or disengages power and prevents a machine from starting up or beginning a cycle when the guard is open. Replacing the guard should not automatically restart the machine. All movable guards (such as doors) should be interlocked to prevent unprotected access to hazards.

Guarded by Location
To be guarded by location, hazards must be unreachable based on where they are located. Employers may accomplish this by positioning operation areas away from hazards or by

installing barriers with limited, locked entry. Some regions don't require guards when the distance to hazardous moving parts is greater than 8 feet (2.5 meters) above floors, walkways, and other walking and working surfaces. Employees must follow lockout/tagout procedures if anyone or anything must pass between the guard and hazardous moving parts.

Safeguarding Devices

Safeguarding devices may use sensors to detect or prevent inadvertent access to a hazard. Safeguarding devices may detect intrusion into dangerous areas, such as the point-of-operation and/or ensure personnel are in safe locations before the machine cycles. Safeguarding devices must not unlock guards or allow access until the machine is in a safe state, such as when it stops moving. When the machine stops, normal operation will not resume without a manual reset from a safe area. Examples include photoelectric sensors, two-hand controls and gates.

Work Practices

Work practices help us ensure that guards are effective and further reduce the chance that people will contact hazardous moving parts.

- Remember that equipment may begin running unexpectedly
- Practice good housekeeping to remove slip, trip and fall hazards
- Report safety concerns and suggestions
- Routinely check machine guards and safety features
- Block unsafe areas and report missing or damaged guards
- Use appropriate tools for feeding and removing materials
- Secure or remove loose or dangling clothing or items that may become entangled in machinery
- Wear the personal protective equipment (PPE) required by your employer

Lockout/Tagout

Lockout/tagout procedures are designed to control hazardous energy when servicing and maintenance activities require that guards must be removed, bypassed or otherwise defeated. Use your employer's lockout/tagout procedures during servicing and maintenance activities. Never reach around, through or beyond the plane of a guard into the machine operating area without first performing lockout/tagout procedures.

Emergency Stop Devices

Emergency stop devices are designed for people to use as a reaction to an incident or hazardous situation. Activating an emergency stop will stop hazardous motion as quickly as possible. Emergency stopping is abrupt and can damage machines, so do not use it as a routine operator control.

Hydraulic Safety

IMPORTANT: Only qualified employees who have received in-depth, machine-specific installation, servicing and maintenance training should build, dismantle, maintain and repair hydraulic systems.

Hazards
Hydraulic system hazards include:

- Struck-by or caught-between injuries
- Severe cuts
- Injections of hydraulic fluid
- Crashes, falls and flying objects
- Burns
- Fires and explosions

Safety Programs
Having qualified, trained employees properly install, inspect and maintain hydraulic systems helps to prevent the release of pressurized fluids due to the failure of hydraulic system components.

Employers should establish a program for these qualified employees to regularly inspect and replace hoses, fittings and other components in accordance with manufacturer instructions.

Operators should visually and operationally inspect hydraulic systems before using equipment to complete work tasks. Everyone who works around hydraulic systems must be aware of the visual and operational indicators of impending failure so that they can react safely BEFORE failures occur.

Visual Inspections
Leaks
Observe hoses and couplings for leaks. Note that discoloration, dirt and greasy buildup may indicate a leak.

If you suspect leaks, do NOT use the equipment; consider hose and fitting replacement.

NEVER touch or examine hose assemblies. Qualified employees will service a damaged hose when they are sure that the hose no longer contains fluid under pressure.

Blisters and Deformations
Look at the outer covering of hydraulic hoses

Remember: Observe the system for problems at a distance. Use a flashlight, if needed.

If you find blisters or deformations, do NOT use the equipment. Your maintenance team may consider hose and fitting replacement.

Cuts, Damage and Corrosion

Observe the system for:

- Cuts, excessive abrasion or scrubbing on hoses
- Cracked, damaged or badly corroded fittings

Operational Inspections

After passing a visual inspection, perform an operational inspection to check for indicators of impending failure BEFORE using the hydraulic system. Wear the personal protective equipment required for operation during the inspection. At a minimum, this usually includes safety glasses or goggles and gloves. Be aware that high-pressure fluids can penetrate normal work gloves.

If there are ANY operational issues, STOP and enlist a qualified employee to further investigate and determine next steps:

- Banging, knocking and high-pitched whining **noises** are often caused by air bubbles and vapor cavities in the system due to leaks, clogs or low fluid levels
- When **fluid temperatures** are too high, they can damage seals and cause other system problems
- Poor **performance**, such as longer cycle times or slow or erratic movements, may indicate low fluid levels or leaks

Problems During Operation

If…	Then…
Hydraulic system jams	Stop, call for maintenance and stay out of the way
Hoses fail during use	Shut down equipment and leave the area, then call for maintenance

Safe Work Practices

Precautions

When you work around hydraulic systems:

- Consult the Safety Data Sheet (SDS) for fluids
- Clean up spills and keep the work area clean to avoid slips and trips

Qualified employees must shield hydraulic lines from welders and torches.

Qualified employees should ALWAYS replace damaged hose assemblies rather than repairing them.

Lock Valves

Lock valves store pressure in hydraulic lift components to prevent loads from accidentally dropping if they lose power or if hydraulic lines suffer damage or burst.

Qualified workers use special procedures to release pressure before working with valves, lines or cylinders of any of the hydraulic systems involved in lifting or stabilizing a machine.

Lockout/Tagout

Your employer has specific lockout/tagout procedures for the equipment at your workplace. Talk to your manager if you have questions.

In general, to control hazardous hydraulic energy, qualified employees have been authorized to perform lockout and will:

1. Turn off equipment
2. Bleed pressure
3. Verify that equipment is de-energized and isolated

There are some general safety tips for hydraulic system lockout:

- Do NOT work under equipment/apparatuses being supported by hydraulics
- Employees who are qualified to do so must block, crib, pin, ground or otherwise secure machine parts that may move, rotate or fall
- NEVER assume there is no pressure in the system just because hydraulic pump equipment has been shut off

Trapped air and other issues can lead to erratic operation following repairs. Non-essential workers should stay away during testing.

Injuries Caused by Hydraulic Fluid

Every company should have a plan for hydraulic fluid incidents and injuries.

If anyone has a hydraulic fluid injury, call for emergency medical help and then consult the SDS for appropriate first aid treatment.

To help medical professionals determine the best treatment, bring the SDS to the treatment facility.

REMINDER: Throbbing, pain, redness and swelling are indications of a severe infection. Do NOT wait for these symptoms to develop; seek care without delay.

Compressed Air Safety Awareness

Compressed air is released at high pressures and speeds to power tools, clean, cool and perform other tasks. It creates hazards like noise, flying objects and static electricity. Having a proactive attitude and taking precautions can help keep people safe.

Personal Protective Equipment
The type of personal protective equipment workers need varies depending on what they are doing and what their employer requires. At a minimum, wear safety glasses or goggles to protect the eyes from flying debris and hearing protection from the noise. Ask your supervisor if you have any questions about what to wear or how to make sure it fits properly.

Work Areas
If workers are using compressed air to clean surfaces, cracks and crevices, materials might be blown into their faces. Airborne particles can be breathed in or become lodged in skin and eyes when they move at high speeds.

Suspended dust and debris can also create combustible clouds. Choose processes that produce less dust, use local capture exhausts and clean frequently to avoid combustible dust clouds. Vacuum dust and debris rather than blowing it around.

Tools
Know and respect pressure limits! Choose the right tool for the job. Check the pressure limits and load ratings stamped directly on tools and components. Do NOT use tools that lack ratings or that are shop-made or modified. Choose tools designed for pneumatic systems at the maximum system pressure.

Choosing the wrong socket could shoot off the wrench or shatter, creating dangerous projectiles! For example, bright chrome sockets are not generally recommended for impact wrench use. these types of sockets are typically designed for hardness and wear resistance. Hardened materials can be brittle and can shatter under the stress of an impact wrench. a special socket rated for pneumatic impact is a better choice.

Using Compressed Air
Working safely with compressed air requires you to be mindful of the hazards it poses. High-pressure air can cut skin or be injected into skin, eyes, ears and nostrils. Tires, hoses and containers may burst when overinflated. Remember:

- NEVER point compressed air tools at people
- Choose air guns with PRESSURE-LIMITING features
- LIMITING pressure through the nozzle protects against air injection and damage to system components
- NEVER use compressed air to clean people

Regulators may allow workers to use compressed air to clean equipment and work areas only in specific industries and under specific conditions. For example, in the United States regulators require:

- Operators to set the pressure below a threshold, such as 30 psi or 207 kilopascals
- Operators to ensure controls, such as chip guarding, are in place

The hazard or risk assessment would require everyone in the area to wear appropriate personal protective equipment.

Using manuals and procedures can help workers prevent pressure-related injuries and damage. Isolate people during system pressurization in case something goes wrong. Isolate and bleed systems before beginning maintenance or servicing work on them to avoid a sudden release of pressure.

Be aware of:

- **Airborne particles**. Compressed air can launch airborne particles into the air that you may breathe in, so respiratory protection may be required.
- **Combustible Dust**. Compressed air can create or disturb combustible dust, which can ignite and start a fire or cause an explosion.
- **Skin**. Sharp edges on hose fasteners can cause cuts or scrapes, so choose hose fasteners without sharp edges. High-pressure air can cut, abrade and be injected through the skin. Also, oil mist that is exhausted from pneumatic tools can irritate your skin. Cover your skin with clothing and personal protective equipment for protection from oil
- **Noise**. Compressors and pneumatic tools generate noise that can damage hearing. Wear the hearing protection recommended by your employer and the tool manufacturer. System leaks can cause compressors to run continuously, increasing noise, decreasing compressor lifespan and wasting energy. If you discover a leak, report it to your supervisor
- **Static electricity**. Static electricity is a concern in areas that have the potential for flammable concentrations of gases and vapors. That is why you should not use compressed air to pressurize containers that dispense flammable liquids

After Using Compressed Air

After tasks are complete, workers should tidy their work areas. Some **pneumatic hoses** have quick-disconnect fittings that automatically stop air from flowing. But if they don't, you must turn off the air supply at the **control valve**. This is important because the pressure may be contained within a system even after equipment is off.

Once you're done using the hose, put it away properly. Hoses can become a tripping or machine entanglement hazard. Hoses on the floor can also be damaged by trucks, doors and dropped tools. Your employer may install air fittings near points of use and overhead hose reels or racks to keep hoses off floors.

Condensate forms when air is pressurized during compressor use. So, use drain valves to drain air tanks regularly. Doing so will prevent system problems such as oil and condensation buildup, freezing water and corrosion.

Tanks also have a **relief valve** to prevent over-pressurization. Follow manufacturer directions when inspecting system components.

Compressed Air Safety Awareness – Supervisor Audit

Use this guide to support your workers after they complete the *Compressed Air Safety* course.

Inspections
Periodically, walk through the areas in which workers use compressed air. Ask yourself:

- Are workers wearing appropriate personal protective equipment? (minimum: safety glasses/goggles and ear protection)
- Is there any dust or potential shrapnel in the area?
- Are hoses stored and are hose ends secured?
- Are hoses, clamps, and connectors in good working order and properly rated?

Follow-up Questions to Ask Workers
After workers complete the training, take time to verify that they understand how what they learned applies to their tasks.

You may ask them:

- Do you have any questions about how to safely work with compressed air?
- Do you understand what protective equipment you need to wear when you work with compressed air?
- Do you know where to find information about pressure limits on components and tools?
- Do you know the pressure limits of the tools and systems with which you work?
- Have you noticed any safety issues with this work area or the tools and systems in it?
- What precautions do you use when cleaning with compressed air? Compressed air should never be used for cleaning people.

Remind workers to tell you if they see any problems. Emphasize that they should remove damaged components or tools and lock and tag them so others can't use them. When using compressed air for area or equipment cleaning, all employees must wear personal protective equipment.

Worker Observation
After workers take the course, observe them to make sure they are working safely. Remember to praise workers for doing a good job, not just point out when there is something wrong.

When you give feedback:

DO:

- Explain your purpose (safety)
- Assume people don't know the risks
- Lead with the positive
- Be timely and specific
- Express concern
- Be personable
- Restate what they say to you
- Thank the person

DON'T:

- Distract workers
- Assume you know what is wrong and how to fix it
- Make it personal
- Be vague/general
- Write while observing

Hand, Wrist and Finger Safety

To prevent hand, wrist and finger injuries, you need to be able to recognize hazards and know a few simple precautions.

Common Injuries and Causes

- **Wrist fractures:** Are most often caused by trying to break a fall with an outstretched hand. Fractures can also occur when the wrist is caught between objects
- **Hand and finger fractures:** Are generally caused by trapping or twisting the fingers suddenly. Accidentally hitting the finger with a heavy object like a hammer or pipe can also cause a finger fracture
- **Hand sprains:** Occur when the ligaments in the hand or wrist are stretched too far and tear. These injuries can be caused by breaking a fall or handling heavy parts
- **Fingertip injuries:** Fingertips are subject to many different types of injuries: the bones can be fractured, the fleshy part of the finger may be torn, or the fingernail may be damaged. Working with sharp-edged parts increases the potential for these types of injuries
- **Lacerations:** Lacerations or cuts can cause severe bleeding and may also sever nerves, muscles or tendons. Lacerations can occur if you are not careful while handling sharp cutting tools, such as knives or saws
- **Nerve compression:** Results from a swelling of tissues that surround a nerve, causing a loss of feeling or sometimes a tingling sensation. Repetitive movements can cause the swelling of tissues

Identifying Potential Hazards

- **Mechanical hazards** shear, rotate, crush, puncture, etc.
- **Environmental hazards** include heat, sparks, cold, rough-edged materials, electricity, heavy objects, etc.
- **Contact hazards** can be chemicals, alkalis, acids, solvents, etc.
- **Poor housekeeping** increases your risk of injury and includes tools left out, substances not stored, a messy work area, etc.

Increase your awareness of the equipment, energy sources and activities going on around you. Follow your organization's procedures, including lockout/tagout procedures, and job safety analyses (JSAs).

Do NOT use your fingers or hands as brushes or brooms. Avoid contact with hazards. NEVER reach into compactors or balers. If you need to reach something that is in a machine, use an approved rod or grabber.

More Potential Hazards

- Check material for slivers, jagged edges and burrs that can nick or cut (file down, pad or tape sharp edges and wear cut-resistant gloves for added protection)
- **Cutting tools** require you to follow employer practices that may include wearing cut-resistant gloves and sleeves

- **Pinch points** are found where two metal objects come together, like when handling compressed gas cylinders or working around mesh gears, rollers and presses
- **Hazardous chemicals** (such as corrosives) can cause irritation and burns (follow employer and SDS instructions)
- Follow employer instructions for handling and PPE when you may be exposed to **pathogens** (such as bacteria and viruses, especially during medical treatment)
- **Tools and machines** can be especially dangerous because of moving parts
    - Use tools for their intend purposes and follow employer training about hand and power tool safety
    - Make sure **machine guards** are in place
    - Make sure equipment is operating properly. Know your equipment!
    - Do not wear jewelry, such as watches and rings, or loose clothing
    - Use good judgment, be prepared for anything and don't reach where you cannot see
    - Secure materials before applying power tools

Identify "hidden" hazards that could lead to injuries:

- Repetition
- Strain
- Pressure from hand tools
- Vibration from grinders, jackhammers and other vibrating equipment

Inattention can cause critical errors: eyes and mind not on hands/task; hands, wrists and fingers in hazardous areas; and losing grip. Pay attention, pause when you need to, and ask for help.

Ergonomic Factors

Repetitive motion, **vibration** and **contact stress** can harm hands, wrists and fingers. Exposure over months or years can result in serious disorders, like carpal tunnel syndrome.

Symptoms of too much strain or pressure on the hands, wrists and fingers include pain, numbness, tingling, throbbing, weakness, clumsiness and loss of dexterity.

To reduce the risk of injury, alternate different types of work; vary hand, wrist and finger movements; and use power tools instead of hand tools.

Tool Use

- Prolonged or frequent use of tools that vibrate a lot, such as jackhammers or grinders, can lead to damaged circulation, pinched nerves and stressed tendons. Take frequent breaks and wear insulated gloves

Gloves

Gloves serve as a barrier between you and the hazard when you can't eliminate the hazard through other means.

Different types of gloves offer varying levels of protection against hazards like chemicals, water, heat, pressure, vibration, dirt and cuts.

You employer will determine which gloves best protect against the exposures you may encounter using information from Safety Data Sheets (SDSs) and safety assessments. If you have questions about which gloves to wear, please ask.

Wash your hands after potential exposures, after removing gloves, and before eating, drinking, smoking or touching your face.

Other factors when wearing gloves:

- Length (some gloves protect wrists and forearms, such as for welders))
- Gloves must fit properly:
    - If they are too large, they may get caught in moving parts
    - If they are too small, they will be uncomfortable and wear out too soon

Be aware that sometimes you should NOT wear gloves

- Some machines can grab a glove and pull your hand into rotating parts

Because each glove has its own protective qualities and limitations, be sure to consult with your employer to choose the correct hand and arm protection for the job

Your employer will provide guidance about glove care, maintenance and storage.

Check reusable gloves for defects like rips or holes and follow your employer's procedure to take them out of service, replace or dispose of them.

Preventing Cuts and Puncture Wounds

A cut, also known as a laceration, is an injury that results in a break or opening in the skin. A puncture wound is a forceful injury caused by a pointed object that penetrates the skin.

Cuts and punctures can:

- Damage organs, nerves, blood vessels, muscles, tendons, ligaments, bones or joints
- Increase the risk of infection
- Result in exposure to bloodborne pathogens for the victim and for others

Machine Tools

Machine tool hazards exist primarily at the point of operation. This is where body parts can come into contact with the moving parts of the machine or be exposed to debris, such as chips or splinters from turning and boring operations. When working around machine tools, make sure all guards are in place and adjusted properly. Any pinch points created by chains and sprockets or belts and pulleys should be guarded.

Another hazard associated with machine tools is handling the parts and by-products of the machining operation. Turnings and metal shavings, also called metal hay or chips, are by-products of the machining process and can cause severe cuts and puncture wounds. **NEVER USE YOUR BARE HANDS TO HANDLE METAL HAY OR TURNINGS.** Wear gloves that are cut-resistant and are woven in a manner that protects your skin from punctures. Whenever possible, use devices such as a hook or pliers**,** to remove turnings or metal hay.

Powered Hand Tools

Do not operate powered hand tools unless you are familiar with their use and associated risks. When using powered hand tools, always:

- Ensure the guards and safety devices are in place and working properly
- Operate according to the manufacturer's specifications
- Keep your body clear of the point of operation

Extreme care and caution must be exercised when using pneumatic tools that shoot fasteners. These tools are capable of firing a projectile, much like a bullet from a firearm. The pressure setting of the gun must not exceed what's needed for the density and thickness of the material being nailed, otherwise the fastener can shoot through. Powered tools should only discharge a nail or staple when in contact with a solid object.

Hand Tools

Most hand tool injuries are caused by improper use, damaged tools or not using personal protective equipment (PPE).

To reduce your risk potential when using a **knife**, utility knife or box cutter, you should:

- Ensure the blade is loaded properly and the knife is assembled correctly
- Expose just one segment of snap-off knife blades to prevent breakage
- Keep your thumb off of the blade while making the cut
- Keep body parts out of the line of the cut by cutting away from your body

- Replace or sharpen blades whenever they become dull or start to tear rather than cut
- Make several passes when cutting thick material rather than attempting to cut the material with one heavy cut
- Retract blades and re-sheath knives after use

To reduce your risk potential when using a **hand saw**, you should:

- Use a holding device to secure the material to be cut
- Keep your hand and body parts clear of the blade
- Cut using strong, steady strokes
- Maintain a balanced, stable position
- Wear eye protection

To reduce your risk potential when using a **screwdriver**, you should:

- Position your hands to avoid injury if the screwdriver slips
- Use a holding device to secure the part, if possible
- Never use a screwdriver for prying, punching, chiseling or scraping

Hazardous Objects

Objects such as screws, nails, splinters, construction debris and broken glass often have sharp edges and pointed ends that pose a cut or puncture risk.

- **Wooden crates:** always use PPE and the proper tools, use a crowbar or similar tool to safely pry the boards apart, and never place fingers in areas where there is a risk of pinch points
- **Boards with splinters:** wear the proper gloves to avoid a possible puncture wound
- **Materials with exposed fasteners:** take the time to remove the fasteners or bend them over to eliminate the hazard and discard the waste in a safe location
- **Construction materials:** make sure you wear the proper PPE and be extremely cautious of splinters, protruding fasteners and sharp edges
- **Broken glass:** use a broom to sweep the glass pieces into a dustpan, wear hand protection when picking up pieces, and place the pieces in a protective container or wrapping with cardboard before depositing into a waste receptacle

Wire Rope and Metal Banding

Never use your bare hand to check wire rope or cables for frayed strands. Gently pull a rag or paper towel down the wire.

- Wear gloves when banding and when disposing of banding material
- Use the correct tools to cut the bands and keep your body off to the side and out of the recoil path of the banding
- Cut straight across the band to avoid creating a sharp point
- Consider plastic banding as a replacement for steel banding material

Safe Practices

Be alert to potential hazards before an accident happens. Perform a quick risk assessment and take steps to eliminate or minimize risks.

- Recognize unguarded pinch points
- Use the right tool for the job, the right way every time

- Inspect tools and equipment to confirm good operating condition
- Follow lockout procedures before repairing or cleaning machinery
- Follow all safety precautions even if you are in a hurry
- Use the appropriate personal protective equipment (PPE)

Injury Response

Should a minor injury occur, here are some simple steps to follow until your injury can be evaluated:

- First, check to see if the object that caused the wound is intact. If a piece is missing, it may be stuck in the wound
- Then, wash the wound with soap and water to prevent infection
- Allow the wound to bleed freely, unless the bleeding is too heavy to stop on its own. If this is the case, apply pressure until the bleeding stops
- Apply antibacterial ointment and cover the wound with a bandage
- Monitor a healing wound for increasing redness, warmth, tenderness and swelling that might indicate the presence of an infection; seek medical attention early if you might have an infection
- Report all cuts and punctures, no matter how minor, to your employer

Whenever you receive a cut or puncture wound, you need to get a tetanus shot as soon as possible if your tetanus shots are not up-to-date. You need to have had a tetanus shot within the last 5 years if your wound has been contaminated by dirt. Otherwise, you need to have had a tetanus shot within the last 10 years.

For serious injuries, seconds count, so be sure to know how to summon medical assistance, including emergency phone numbers. Remain calm and be prepared to provide emergency responders with information such as your location and the nature of the injury. Only properly trained personnel should provide first aid.

Hand Tool Safety for Construction

Hand tools are not powered by electricity or other sources. Remember that your company may have its own specific policies regarding hand and power tool safety. Review and follow those policies in addition to the information presented in this course.

Hazards
Common hazards associated with hand tools:

- Cuts, scrapes and punctures
- Injuries from falling objects
- Trips
- Electric shock

Preventing Fall Objects
Guardrail toeboards and screens prevent kicking or dropping tools off elevated work surfaces, such as scaffolding. Secure tools in a tool belt or container or lash them to something to prevent falling.

Working with Sharp Tools
Use sheaths and holsters for carrying sharp tools. When you are using cutting tools, cut in a direction that is away from your body.

Rejecting Defective Tools
Do not use any tools with loose heads or damaged handles that may have splinters, burrs, cracks or splits. Tag any worn, damaged or defective tool and store it in a safe place, marking "out of service" on the tag or container.

Using the Right Tools
Finally, and most important, use the right tool for the job. Don't use a knife as a screwdriver, and don't use a screwdriver as a chisel. Don't use a cheater bar or other device to apply pressure to a tool.

Taking Care of Yourself
Rest fatigued joints and muscles by taking short breaks and stretching. A good practice is to take a 2-minute break every 30 to 45 minutes.

IMPORTANT: If you are unsure of the correct precautions in a certain situation, it is your responsibility to get the information you need. Check with your supervisor or consult a safety regulation handbook for additional guidance.

Striking Tools

- Don't strike an object with the side of a hammer
- Don't use a hammer as a wedge or pry bar
- Keep your hands and tool handles free of oil, grease and moisture
- Wear eye and ear protection

Tightening and Loosening Tools

- Fit the screwdriver to the job
- Keep your fingers away from the tip
- Don't use pliers or a hammer on a screwdriver
- Don't use wrenches that are bent, cracked or chipped
- Don't use a cheater bar or pipe to extend a wrench or vise handle
- Don't use a shim to make a wrench fit
- Don't use vises with broken jaw inserts, cracks or fractures
- Don't use a C-clamp to hoist materials
- Don't use a clamp for permanent fastening
- Pay attention to the hand you are NOT using

Cutting Tools

- Avoid "mushroomed" heads
- Control saws by releasing downward pressure
- Keep blades sharp
- When using an axe, make sure that others are out of work range
- Stay out of the line-of-fire
- Never carry a tool by the blade
- Never point the blade toward yourself or a co-worker
- Pay attention to motion and body position
- Wear cut-resistant gloves

Scissor-type Tools

- Don't use pliers as a wrench or hammer
- Don't force pliers by using a hammer or cheater bar on them
- Never use pliers that are cracked, broken or sprung
- Select the appropriate cutter for the job
- Never use cutters around electrical wires unless the wires are de-energized
- Wear safety glasses or goggles for protection from flying bits of snipped materials

Prying Tools

Use a crowbar that contains a grip and a heel. Never use makeshift crowbars.

Digging Tools

- Don't twist your spine
- Put the most pressure on your legs
- Make sure the shovel and your shoes are not muddy, greasy or slippery
- Call the power company to determine electrical hazards. In the U.S., call 811

Smoothing Tools

Grasp the handle with one hand and the toe with the other hand. Never use a file as a pry bar, chisel, hammer or screwdriver.

Power Tool Safety for Construction

Power tools can be dangerous. When you misuse or modify them, they can cause injuries ranging from cuts and scrapes to amputations or even death. The good news is that you can follow some basic safety guidelines to avoid these injuries.

Power Tool Hazards
Hand tools and power tools are alike in many ways:

- Present tripping hazards when on walking/working surfaces
- Can fall onto people below when you're working at heights
- Can penetrate underground and embedded cables and pipes
- May cause harm when you misuse or misapply them
- Are safe when you follow precautions

The energy and speed of power tool operation means that these tools are often less forgiving than hand tools when you use them improperly.

Hazards associated with power tools include:

- Cuts, scrapes and punctures
- Moving parts in which loose clothing, hair or fingers can get caught
- Inhalation and projectile hazards. Power saws and grinders can generate large amounts of dust and high-velocity particles can injure eyes and soft tissue. Wearing goggles and a respirator is often recommended

There are unique hazards associated with the type of **power source** used:

- Electric and battery-powered power tools: Even a short exposure to electric shock can cause severe injury, heart failure or even death
- Pneumatic power tools: If the air hose is punctured or cut, it could result in uncontrolled whipping of the hose
- Gasoline power tools: The fuel can cause a fire or explosion

Precautions
All Power Tools

- Never yank the cord or the hose when disconnecting a tool
- Carry the tool by the handle, not the cord or other part
- Keep cords and hoses away from heat, oil or sharp edges
- Disconnect cords when servicing a tool and when you are changing accessories
- Secure your work with clamps and vises
- Keep your fingers away from the switch or button when you are carrying a tool
- Keep tools sharp, clean and well-maintained
- Keep all safety guards in good working order; never detach or disable a guard (do NOT misuse or modify power tools or their guards in ways that conflict with manufacturer recommendations)

Electrical Tools

- Ensure cords are insulated and intact. Do NOT use a tool with a damaged cord
- If a tool is damaged or broken, tag it "out of service"
    - If you will repair the tool, put it in a safe location
    - If you will not repair the tool, properly dispose of it
- Use devices that automatically shut off stray circuits, such as ground fault circuit interrupters (GFCIs)

- Use grounded cords with three intact progs or use double-insulated tools
- Store tools in a dry area
- Wear appropriately rated gloves and protective footwear

Powered Abrasive Wheel Tools

- Perform sound and ring testing before mounting a grinding wheel
    - If the wheel is good, it will have a clear, metallic ring
    - If it sounds cracked or dead, consider it to be dangerous because it could fly apart during operation
    - A safe practice may be to run the equipment for 30 seconds or more to ensure it is mounted properly
- Make sure the wheel or disc is appropriate for the tool size and speed ratings
- Wear eye and face protection

Pneumatic Tools

- Wear hearing, eye and face protection
- Adjust the power to prevent projectiles from over-penetration
- Be in firm contact with the work surface before discharging the tool
- Never point a pneumatic tool toward yourself or others

Cartridge (Powder or Explosive) Tools

- Do NOT use on thin materials such as plywood or drywall
- Never point the tool at yourself or anyone else
- Don't load the tool until you're ready to use it
- Don't leave a loaded tool unattended
- Wear eye and face protection
- Choose the cartridge needed for the tool and application
- Be in firm contact with the work surface before discharging the tool

NOTE: Because of the danger associated with cartridge tools, some locations may require workers to have a special certification before operating them.

Hydraulic Power Tools

- Hydraulic fluid can cause irritation to the skin and eyes and may be injected into the body where it may kill tissue
- Never use your hands to search for leaks. Instead, use a piece of cardboard or wood
- Before disconnecting lines, be sure to relieve pressure
- Before applying pressure, be sure connections are tight and fittings and hoses are not damaged
- Always use the manufacturer's recommended safe operating pressures for the hoses, valves, pipes, filters and other fittings

Lithium-Ion Battery Awareness

Lithium-ion batteries are everywhere and power many items that you use daily. Small electronics like cell phones and power tools and bigger items like electric or hybrid vehicles can be powered by lithium-ion batteries.

What Is a Lithium-Ion Battery?
A lithium-ion battery is a rechargeable power storage device in which lithium ions move through an electrolyte from a negative electrode to a positive electrode during battery discharge. When the battery is charging, the process is reversed.

Lithium-ion batteries need warning labels during shipping, but are not always individually labeled. Owner/operator manuals and chemical inventory lists should identify lithium-ion batteries.

Unique Properties
- Stores a large amount of power in a small, lightweight package
- Fast charge
- Slow discharge

Unique Advantages
- Battery-powered devices are easier to operate, transport and store because they are lighter and less bulky
- Ready to use sooner
- More likely to be ready for use after periods of idleness

Unique Hazards
- Electrolyte is flammable, toxic and corrosive
- Thermal runaway fires are possible and difficult to extinguish
- Fires emit toxic smoke

Hazards
Defect-free lithium-ion batteries are not flammable or toxic during normal use, but can fail and be dangerous if not handled with care.

What Could Happen?
- Fires and explosions
- Chemical exposure
- Electric shock

Incident Prevention

Identify warning signs of battery failure to prevent safety incidents:
- Physical damage
- Hot
- Swollen
- Leaking fluid

- Emitting foul odors or hissing sounds

Safe Work Practices

- Wear safety glasses during battery maintenance or service
- Remove conductive jewelry and items from pockets
- Use non-conductive tools
- Follow manufacturer recommendations
- Do not mix old, new, charged and uncharged batteries
- Replace like-for-like batteries
- Use batteries, chargers and devices bearing the mark of a recognized testing laboratory

Safe Charging

- Use compatible chargers – incompatible chargers can overcharge the battery
- Charge batteries in a safe place
    - Non-combustible surface
    - Uncovered to allow venting of heat
    - Away from direct sunlight and heat
- Unplug the charger after the battery is fully charged

Batteries Outside of Devices

- Store in a cool, dry place
- Cover terminals to prevent short circuiting
    - Use electrical tape to cover each terminal, and/or
    - Enclose each battery in a durable, plastic, zip-top bag

Battery and Device Disposal

- Recycling is preferable over trashing
- Do NOT recycle or trash batteries with uncovered terminals

Incident Response

Fire or Explosion

- Assess the situation
    - Extinguish small fires if trained to do so
    - Leave large fires to a professional
        - Do NOT fight a fire unless you are trained to do so!
- Evacuate the area
- Call for help or extinguish the fire
- Keep extinguished batteries away from combustibles; they could reignite

Other Incidents

- If there isn't a fire or explosion, but a battery shows signs of malfunction, unplug the charger if it is safe to do so
- In case of skin, eye or respiratory contact:
    1. Move to fresh air.
    2. Flush the area with water.
    3. Seek medical attention.

Struck-By, Caught-Between – Staying Out of the Line of Fire for Construction

Hazards cannot be avoided or controlled unless they can be recognized. Once you recognize hazards, assess risk and implement controls to eliminate or reduce the risks.

Monitor the proximity and motion of equipment and people around you. Be aware of warnings. Follow safety instructions. If you have questions or concerns, STOP until you get clarification.

To control struck-by and caught-between hazards, in order of preference, we:

1. ELIMINATE THEM by keeping people out of the line of fire
2. SUBSTITUTE safer equipment and processes
3. Provide ENGINEERING CONTROLS at the worker level
4. REDUCE exposure through safe work practices, training and job rotation
5. USE PPE for added protection

Worker-Level Control

- Complete safety training and use methods to safely operate equipment
- Pay attention to information from your employer about the hazards of activities in your work area and precautions you need to take as determined by pre-task planning
- Anticipate what might happen when operating equipment and when required to work near equipment being operated by others

Coordinating with Heavy Equipment Operators

- Don't assume the other person sees you
- Watch out for yourself and others
- Don't get complacent

Line of Fire or Danger Zone

Stay out of the line of fire (danger zone).

- Be mindful of crane swing radius
- Don't walk under a load being lifted by a crane
- Go **around** the area that might be hit if the load were to suddenly shift or a portion of it were to drop from above

Other predictable danger zones include situations where:

- Welding and cutting slag is thrown downward and in the direction of cutting
- Broken towing and lifting lines recoil violently and predictably
- Uncoiled roll material recoils predictably
- Unstable materials shift predictably
- Chemical vapors and dusts migrate downwind in a predictable fashion
- Debris chutes and refuse containers are filled

Struck-By and Caught-In or Caught-Between Hazards

Work Zones

There is a lot of movement on a construction site requiring your awareness and coordination to prevent incidents. Work zones should have marshalling plans that include who will safely direct vehicle movement. In routes where worker traffic enters and exits the work zone:

- Equipment operators should know where the entrances and exits for workers are located
- Be aware of traffic moving through those areas
- Workers should not rely on the drivers of these vehicles seeing them. It is each worker's responsibility to be aware of vehicles and avoid them

Heavy Equipment

Remember that heavy equipment can't stop fast or maneuver quickly. When it stops, it can shift the load and the operator may lose control of the material being transported

When heavy equipment is in the zone:

- Spotters should be used when equipment is backing up
    - Spotters must maintain an appropriate distance from backing equipment and remain aware of obstructions and traffic
- Make yourself aware of the spotters and the various alarms that indicate a piece of equipment is backing up, because the driver may not see you
- Make sure you are not in the path of the hazard/equipment. If you are, ensure that either the spotter or the operator has seen you
- If you see a piece of equipment above you on an incline, move away from the path of the hazard if it were to roll
- When you hear an alarm, locate the source, evaluate where the material is being dumped, and ensure you are not in the danger zone
- Be aware of crush points on moving pieces of equipment and ensure that you are not between them and a solid object
- Know the paths of escape or egress in the immediate area

Overhead/Scaffold Work

Scaffold failures can be catastrophic to a worksite and worker safety. Scaffolds must be inspected and tagged daily. If a scaffold doesn't look or feel right, do not use it and report it to your supervisor. You are at risk of being struck by falling objects when you are beneath scaffolding or where other overhead work is being done.

Overhead work controls can help prevent injury.

- Stack materials to prevent sliding, falling or collapse
- Wear a hard hat and other PPE
- Make sure toeboards, nets and other controls are in place

Scaffolds must be designed by a qualified person and inspected daily and as needed by your jobsite Competent Person. Report any concerns to the Competent Person.

When overhead utilities are present:

- Provide spotters when people and equipment will be working near the lines
- Make sure that you are out of reach of a power line that might be severed by a piece of equipment and fall to the ground
- Touching or being too close to a power line can result in arcing, fires and electrocution

Know about area obstructions and respect overhead clearances.

- Equipment tip-overs and pinching/crushing injuries are possible if equipment contacts an overhead structure or other obstruction
- Survey work areas for clearance issues and obstructions and always look in the direction of travel to avoid contact

Public Traffic

Be aware of any public traffic through the work zone:

- Know where the traffic is and how close you will be to it
- Wear high-visibility, reflective work wear that complies with ANSI/ISEA 107 or equivalent international standards to increase your visibility to drivers and to co-workers (zip vests closed)
- Watch for oncoming traffic that may not be aware of you and be prepared to quickly move out of the path of the hazard at the first sign of danger
- Always face oncoming traffic

Constructing Masonry Walls

Implement these worker-level controls when working around masonry walls:

- Identify the boundaries of the work area and the fall radius in every direction (where pieces may end up if the wall collapses)
- Stay out of the work area unless you are essential to and actively engaged in the construction or lifting operations being conducted
- Be aware when heavy equipment is working near the wall, especially when it is on the other side of the wall from you
- Pay attention to wind speed and direction
    - Directional wind shift can change where the wall might fall
    - Suspend work activities during periods of high wind
- Involve qualified persons when making decisions regarding proper bracing against wind and lateral forces and removal of temporary bracing
- Important: A hard hat can mean the difference between life and death if struck by a falling brick or other material

Projectile and Entanglement Hazards of Tools/Equipment

Projectiles may be created by the interaction of materials, tools and equipment. They may come from adjacent work, even above and below you. To avoid injury:

- Maintain guards on tools that rotate (saws, grinders, etc.)
- Choose the appropriate tool for impact tasks and avoid impact tools with mushroomed striking surfaces
- Wear eye and face PPE when people are hammering, chipping, and using pneumatic or powder-actuated tools in your work area

- Observe clearances and heed warnings at blasting sites
- Never use compressed air to clean people
- Check with your supervisor before using compressed air to clean equipment and areas (specific regulations and controls apply)

Pay attention to machine hazards.

- Moving parts such as motors, power transmission shafts, pulleys, gears, chains and belts can be hazardous
- Machine guards are placed around moving parts to lessen the chances of inadvertent contact with mechanical hazards
- Ask your supervisor for help determining tools and work practices to use when guards must be removed for tasks
- Decals and markings are commonly placed near machine danger zones
- Do not wear loose, untucked clothes, and pull back and restrain long hair
- Take note of hazards mentioned in equipment operating manuals, follow stated precautions, and ensure machine guards are maintained where required

Excavation/Trenching Work

Worker controls that you can implement mostly occur before you enter the trench. These controls include:

- Proper design including trench boxes and other shoring, sloping or benching, as needed
- Daily inspections by your crew's Competent Person to check for indicators of possible cave-in (cracking of sidewalls and materials sloughing off of the side walls)
- Making sure spoil piles/equipment are back from the edge by at least 0.6 meters (2 feet)
- Noting the position of equipment that could slide into the trench and catch you between the equipment and the ground
- Making sure you have means of quick egress from the trench, such as ladders or ramps

Personal Protective Equipment (PPE): Body Protection

Hazards
Based on your workplace's hazard assessment, you must wear body protection whenever hazards are present that could cause bodily injury, such as:

- Intense heat/cold
- Splashes of molten metal and other hot liquids
- Impacts or cuts from tools, machinery and materials
- Hazardous chemicals
- Blood and other potentially infectious material (OPIM)
- Radiation
- Electrical hazards such as burns from arcing

PPE may not prevent all injuries but can reduce the severity of an injury.

Types of Body Protection
To protect against specific hazards, you may need to wear one or more of the following:

- Vests for cooling purposes, visibility and abrasion protection
- Jackets that provide a thermal barrier, offer high visibility or are flame-resistant
- High-visibility safety apparel
    - Required when working in certain environments such as construction sites, areas with heavy machinery and vehicles, and places where work is carried out in poorly lit areas
    - Must meet ANSI/ISEA 107 standard (Class 1, 2, 3)
- Aprons
- Coveralls
- Surgical gowns, smocks and lab coats
- Fully encapsulating body suit
- Electrical protective suit
- Skin protection (sunscreen and insect repellent)
    - Wear sunscreen with a sun protection factor (SPF) of at least 15
    - Wear insect repellent to protect against potentially harmful insects such as mosquitos and ticks. Repellants containing DEET have been proven to provide more effective protection

Selecting Body Protection
It's important to select the type of body protection that will protect you from hazards in your workplace.

- **Paper-like fiber** is often used to make disposable suits that provide skin protection against dust and splashes
- **Treated wool and cotton** clothing is used for protective clothing because it adapts well to changing workplace temperatures and is comfortable and fire-resistant
- **Cotton duck** protects against cuts and bruises when handling heavy, sharp or rough materials
- **Leather** protective clothing is often used against dry heat and flame

- **Rubber, rubberized fabric, neoprene and plastics** are all used to make clothing that protects against certain acids and other chemicals

Wearing Body Protection
Whatever type of body protection you are required to wear in your job, you must know how to put it on (don) and take it off (doff) properly. You must receive hands-on training covering:

- How to don the protective clothing properly
- How to adjust for a comfortable and effective fit
    - Body protection should fit the person, be comfortable and allow for movement
- The limitations of the body protection you will wear
- How to doff, store and dispose of PPE

Heat Load
Wearing PPE and certain clothing can increase your risk of heat-related illnesses. To help prevent heat stress and other heat-related illnesses when wearing PPE, your employer should consider the:

- Type of PPE (for example, wearing heat-resistant clothing when working with high-temperature hazards)
- Length of time an individual can wear the PPE
- Individual worker's actual work rate, fitness level, hydration level and acclimatization
- Environmental conditions
- Access to cooling vests, which can help prevent heat stress
- Implementation of work-rest cycles when above 26.6 °C (80 °F)

Inspection
Before you wear any kind of body protection, check it for signs of damage such as rips, tears, stains, scuffs or loss of elasticity. Check for overall fit, seals, gaps and range of motion with other PPE. If the body protection is damaged or fails inspection, do not use it, remove it from service and notify your supervisor.

Always follow manufacturer guidance and instructions when inspecting your PPE. If your PPE has a date of manufacture and service life, make sure that you are within the specified lifespan of the PPE.

Take Care of Your PPE
Contaminants
Always follow the manufacturer's guidance and instructions for cleaning, sanitizing and storage requirements. Many contaminants can be removed by rinsing or dissolving. Using surfactants, such as mild detergents, makes contaminants dissolve more readily and reduces their ability to stick to impermeable surfaces.

You can also remove contaminants by scraping, brushing or wiping the equipment. A low-pressure filtered vacuum is an acceptable option compared to compressed air, which can result in skin, eye and respiratory issues.

Contaminants can be removed through evaporation, then rinsing, and through chemical disinfection or neutralization. Shared PPE, such as a corrosive apron, must be cleaned and/or disinfected between users.

Materials

The cleaning method you use will depend on the type of PPE and the material it is made of.

PPE Material	Cleaning Method
Protective suits and chemical-resistant clothing	Use mild soap and water or dispose of them as hazardous waste if grossly contaminated or permeated with contaminants.
Coveralls and long underwear	Launder at industrial laundry facilities, notifying them of potential contaminants. If laundering on-site or at home, if allowed, contain the item and wash separately from other garments and personal clothing.
High-visibility safety apparel	Follow the manufacturer's instructions on the label.
PPE made of leather	Do not wash directly with water. Apply a small amount of moisturizing bath soap and water to a dry cloth, rub the PPE clean, and wipe off soaped areas with a damp clean cloth.
PPE made of rubber	Can be soaked in soapy water and scrubbed with a soft brush, depending on the contaminant, and rinsed with clean water.

Storage

Each manufacturer of PPE provides care, use and storage requirements but, as a general rule, your PPE should be kept:

- Clean
- Dry, preferably sealed in its original packaging or another sealed bag
- Free from compression by heavy objects
- Secure from theft or tampering
- Away from environmental factors, extreme temperatures and sunlight

Disposable protective suits must be disposed of after each use. If contaminated, you must dispose of it as hazardous waste.

Work Zone Safety, Part 1: Preparation

When you work construction on or near roadways, pedestrians and motorists are a factor that you must consider. Work zone safety protects the public and workers from accidents and minimizes the negative impact of the project on the community.

Traffic Control Standards and Plans
The most common traffic control standard in the United States is the **Manual on Uniform Traffic Control Devices (MUTCD),** part 6. States follow MUTCD and may have additional requirements that you and your employer must confirm before beginning work.

Workers in work zones must:

- Follow the traffic control plan
- Provide clear, consistent signs, markings and other visual cues
- Perform routine day and night inspections
- Be aware that conditions can change unexpectedly

Traffic control plans should include ALL types of traffic, be in writing and be approved by local authorities. The agency that has jurisdiction over the work zone must approve modifications to the plan. Your employer will provide traffic control plan safety instructions where you work.

Five Areas of Work Zones
The five areas of work zones are the:

- **Advance warning area**. It warns the public with increasingly specific signs as they approach the work area. The spacing and placement of signs will vary depending on speed and visibility.
- **Transition area**. It is where traffic moves from its normal path via detours, lane changes and tapers.
- **Buffer area**. It gives motorists who cross over traffic control devices time to react and stop before striking anyone. Keep free of materials, equipment and people.
- **Work area**. It contains workers, tools, equipment, material, vehicles and debris. Ensure that there are safe ways to enter and exit the work area that dissuade or prevent unauthorized entry.
- **Termination area**. It is where traffic passes beyond the work area and resumes normal movement. Tapers should be about 100-feet long and use 5 to 6 traffic control devices per lane. Many termination areas include termination signage.

Work Zone Inspections
Perform routine daily and nightly inspections, even when work is stopped. Look for skid marks, damaged barricades, dirty/displaced traffic control devices and material, equipment and debris infringing on traffic lanes. Failure to inspect and correct issues can lead to liability and accidents.

Include other workers in inspections. Fix problems as soon as you find them, if you can. Block hazards to prevent accidents. Document inspections and corrective actions.

Work Zone Safety, Part 2: Operations

Keeping everyone safe in work zones requires tools, practices and people.

Traffic Control Devices (TCDs)
Traffic control devices (TCDs) provide advance warning to motorists, delineate travel paths, and separate traffic from workers. Examples include:

- Signs
- Drums
- Cones
- Message boards
- Chevrons
- Barricades
- Concrete barriers
- Traffic lights

At a MINIMUM, TCDs must be clean, maintained and made of approved materials (not homemade). Specific requirements for TCDs are in your work zone safety plan, which should meet or exceed the *Manual on Uniform Traffic Control Devices* (*MUTCD*) standards.

Ensure TCDs:

- Are applicable
- Don't have conflicting instructions/information
- Have directions/arrows pointed where traffic should go
- Are placed/distanced appropriately

Traffic cones must be:

- Orange
- Reflective (for night use)
- At least 28" tall
  (states may require taller)
- Weighted or doubled to stay upright, as needed

Drums must:

- NOT be recycled 55-gallon drums
- Be lightweight and flexible
- Be at least 36" by 18"
- Have closed tops
- Be orange with white stripes
- Have drain holes for water buildup
- Be weighted, as needed

Traffic control devices need enough weight to be stable, but not so much that they can become missiles. Place weights low, and do NOT place weights on top of the TCD or use weights made of concrete.

Safe Practices
Wear **high-visibility gear** in work zones. Choose fluorescent colors that contrast with your surroundings as much as possible. You may need to wear garments that reflect light off fronts, sides and back. Keep traffic vests and reflective garments clean, maintained and visible.

When you are in a work zone:

- Face oncoming traffic (even when resetting displaced drums)
- Instead of bending near open traffic lanes, use your foot to position traffic cones
  - Be aware of construction vehicles and equipment (listen for backup alarms)
- Stay within the work zone and out of the buffer area
- Do not cross open lanes of traffic

Correct problems immediately. When you see problems that you can't fix right away, tell your supervisor and follow up to ensure resolution. When inspecting/traveling, stay in the vehicle cab and wear your seatbelt.

Know emergency procedures and warning signals for uncontrolled vehicles. For motor-vehicle accidents in the work zone, follow company procedures, assist people carefully, and watch out for secondary collisions.

Night Operations

Night operations may enjoy less traffic, but there are also dangers of which you should be aware, including: reduced visibility, speeding drivers, impaired/fatigued/inattentive drivers/workers and lights blinding drivers/workers. To increase the visibility of operations at night:

- Wear vests OVER other clothing
- Use lights aimed away from motorists
- Give flaggers light wands or chemical light sticks
- Lay flares on the ground (do not hold them)

Flaggers

Flaggers alert motorists to the presence of a work zone and communicate to them about where to stop and how to proceed. They should be:

- Experienced
- Healthy
- Professional
- Assertive
- Trained/ knowledgeable about work/safety
- Certified (in some states)

Place advance warning signs before flagging stations. These may include: "Road Work Ahead," "Flagger Ahead," or "Prepare to Stop." Make sure stations are visible; consider all conditions and factors. Plan an escape path in case something goes wrong.

Use stop/slow paddles that meet or exceed *MUTCD* and other applicable standards: 18" x 18" octagons with 5' to 7' handles. Only use flags in emergencies. Contractors may be exposed to liability if a non-standard device is involved in an accident. Signals and directions to motorists must be clear and distinct. Only give **three commands: stop, go, and slow down**.

Flaggers must ALWAYS be visible:

- Don't mingle with other workers
- Wear distinctive vests and gear
- STAND UP
- Do not park vehicles near flaggers

Flaggers should:

- Remain professional and polite
- Keep conversations brief
- Stay visible to all traffic

Vehicles and fixed objects can impair visibility and block escape routes in case motorists don't respond to directions.

Dealing with Angry Motorists

When dealing with angry motorists, alert the crew, record what happened, note the vehicle description/ plate and driver description, and call the police. Do NOT argue, retaliate or try to stop the vehicle.

Demolition Hazards

Demolition is a complex activity that involves a variety of serious hazards during the scope of the project. Health and safety precautions are listed in EM-385-1-1 and OSHA 29 CFR 1926 Subpart T. Only qualified workers may perform demolition work. Additional training is required before people may be on the site or perform demolition work.

Preparing for Demolition
Before starting any demolition or renovation work, a **registered professional engineer (PE)** must perform an engineering survey, develop a demolition/renovation plan and assess how to safely work on previously damaged structures. Demolition contracts, insurance brokers and property owners all require the documented demolition/renovation plan.

A registered PE performs a **structural survey** to assess the structural integrity of the building and its components. If load-bearing structures will be removed or demolished, they must complete an **engineering survey**. The PE will determine the type and condition of the framing, floors and walls to decide how to prevent the premature collapse. The PE may also check adjacent structures for demolition hazards.

The registered PE will create a **demolition or renovation plan** and submit it to the project owner for approval. The plan must include controls or corrective actions for listed hazards. At a minimum, the plan will include:

- Project schedule
- Scope of work
- Work methods
- Equipment
- Key personnel
- Site preparation methods
- Waste management plan, including asbestos-containing materials (ACM) and other regulated materials (ORM)
- Site restoration plan
- Specific requirements, as directed by the project owner

Managers will instruct all workers involved in the demolition/renovation activities about the details of the plan.

If the structure was damaged before demolition begins, the PE will advise the team about shoring or bracing structure components to prevent premature collapse. The PE may decide to perform additional engineering surveys for structural damage caused by fires, floods, explosions or other significant events.

Preparing: Utility Control
Utility service lines may contain electricity, water, gas, sewage or steam. Engineered drawings (site/utility plans) must show the location of all service lines along with their controls. Shut off, cap or properly control the lines inside and outside the building before demolition begins. If utilities are necessary during demolition, temporarily relocate the lines and isolate them.

Notify controlling utility companies in advance if you plan to shut off, control or reroute their lines. An authorized member of the utility company may be required to shut off or cease service to the building for certain utilities.

The project owner must identify and verify disconnection points and de-energize electric connections and service lines. Workers, including contractors, must confirm proper utility control or de-energization prior to starting their work. Lock out de-energized electric lines. Contractors must follow energy isolation procedures and verify all lockout.

Confirm that chemical fire suppression systems are deactivated and depressurized and that all of the chemical mixture is removed from the system before demolition begins. Submit confirmation to the project owner.

Preparing: Hazardous Materials

Hazardous materials may include:

- Chemicals, including PCBs
- Building materials, such as asbestos
- Gas
- Explosives
- Flammable materials
- Dangerous substances, such as lead-based paint, mercury-containing devices and biological hazards

A qualified person must identify any hazardous materials that are in the structure or stored in any pipes, tanks or other equipment within the structure.

Eliminate or control hazards by following any required local standards and regulations before the work begins. Properly dispose of hazardous materials following regulatory and project owner requirements. Stop the work and notify the project owner if anyone discovers hazardous materials during demolition.

Protecting the Site and People

Protect the demolition site from unauthorized people. Close, relocate or properly protect public areas close enough to be affected by the work. Post warning and restricted access signs where people could attempt to enter the work area.

Protect worker entrances and the area at least 8 feet (2.4 meters) out from the building from falling materials, debris or other hazards by using sidewalk sheds, canopies or both. Sidewalk shed roofs require a minimum of 2-inch-thick planking. Canopies must be at least 2 feet (0.6 meter) wider than the entrance to the building. Both sidewalk sheds and canopies must be able to support loads of at least 150 pounds per square inch (PSI).

Workers may only use dedicated stairs, passages and ladders to access the work area. Cover stairwells at least two floors below the work to protect people from falling debris. Make sure passages are well-lit, clear of obstacles and protected from hazards. Inspect ladders regularly and before each use to make sure they are in good condition.

Each site that has demolition work must have a fire and evacuation plan before any work that involves fire hazards begins. Hot work (such as welding, cutting, brazing, grinding and thawing) requires additional permits and planning. Fire and evacuation plans should include duties, procedures and instructions for fire protection and control. Appropriate fire extinguishers should be fully charged and easy to access throughout the work area and in mobile equipment. Everyone must know what to do during fires or evacuations.

All workers who will be exposed to hazards during demolition must be protected with appropriate controls, including PPE. Workers should perform a hazard analysis to identify the necessary PPE before anyone begins to work. The type of PPE that workers need varies depending on the hazards that may be present. It may include protection for heads, eyes, hearing, hands, feet and breathing. Workers may choose to wear dust masks, even if they are not required. See 29 CFR 1910.134, appendix D for more information. The employer must develop a respiratory protection program if workers must wear respiratory protection. Workers who work at heights may require fall protection in addition to engineering and other controls.

During Demolition
Demolition of floors and exterior walls happens in phases and according to the demolition/renovation plan and risk assessment. The phases often begin at the top of the structure and proceed downward from there. Exceptions include cutting holes in floors for trash and materials and creating storage space.

Control and contain glass breakage and fragmentation hazards in and out of the demolition zone, especially if the structure is near a public area. Protect or remove glazed openings.

Floors and working surfaces must be strong enough to support loaded mechanical equipment. Load handling equipment (LHE) must have a certificate of compliance, inspection documentation, operational load testing information and lift plans. Only use mechanical equipment and LHE as intended by the manufacturer. Operators must be trained and, in some cases, certified to use the equipment. Make sure training records and certifications are up to date.

A competent person must identify hazards during demolition that are caused by removing material, removing support structures or general demolition activities. The demolition and renovation plan identifies competent persons and the frequency of inspections. If the competent person identifies a hazard, work should stop until it is corrected, such as with shoring, bracing and support. Do not return to the area until the competent person verifies that the hazards are controlled.

Debris
Safely removing debris is important to protect workers and the public. Remove debris promptly to prevent trips and falls. To prevent harmful airborne dust, use controls like water misting, temporary screenings, curtains and flame-retardant barriers. Be aware that water misting may increase slip, fall and electrical hazards.

Use **chutes** to quickly remove debris from elevated floors. Chutes must be able to withstand the impact of materials or debris. Ask your supervisor before using chutes if you have questions about their capacity.

Chutes must have guardrails at least 42 in (1.1 m) above the floor or area where workers will stand to dump debris. Secure a toe board or bumper at least 4 in (10 cm) high to the chute opening if people will use equipment to dump materials into a chute. Enclose chutes with angles greater than 45° from horizontal surfaces. Chute opening walls should not be higher than 48 in (1.2 m). Keep chute openings securely closed when no one is using them.

Install a substantial gate at the discharge end of the chute. A trained and designated worker must be at the end of the chute to operate the gate and control backing and loading trucks. Close and secure the area around the discharge end of the chute when no one is using it.

You may remove floor joists from wood floors to create debris storage space only if the joist is no more than one floor above grade and removing the joist and dropping debris will not compromise the stability of the structure. When you are removing floorboards to create chutes, leave wooden floor beams and other support structures that are bracing walls in place until you can replace them with another adequate means of support.

Use bumpers or curbs, also called stop-logs, to prevent equipment, tools and other items from falling over the edge of **floor openings**. Disposal floor openings cannot be longer than 25% of the total floor area unless the lateral supports of the removed flooring remain in place. Shore any floor weakened or damaged by work activities to safely carry its intended loads. Solidly plank floor openings within 10 feet of any wall that people are demolishing. The only exception is if workers are kept out of the area below the opening.

Debris may contain regulated waste, asbestos-containing materials (ACM) or other regulated materials (ORM), depending on the age and use of the building. The project owner must approve of the disposal site. Be prepared to provide documentation that confirms proper disposal, including waste types and quantities.

Structural Demolition

Structural demolition involves physically dismantling a structure by removing structural components. Remove or abate ACM or ORM. Ensure that only the workers tasked with removing ACM and ORM are in the area. Their work must be complete before structural demolition begins. Before a structural demolition, workers may need to remove universal waste, complete a partial demolition to frames and/or do a soft demolition. Structures can be removed whole in some cases.

Removing **walls** can affect the structural integrity of the building. The floor must be able to sustain the weight of collapsed walls. Break large walls into smaller sections and remove debris from the area as you go. Do not work on top of the walls unless you control associated hazards, such as falls, traction and safe access and egress. Do not store debris or other materials in walls.

Support any walls that are higher than 6 ft (1.8 m) with lateral bracing unless they are in good condition and designed to stand without support. Keep the time that walls stand without lateral bracing as short as possible. Remove the stories above load-supporting or structural walls before demolishing them. Leave steel framing in place during the demolition of masonry support. Clear each steel component of masonry debris before proceeding. Remove or brace the earth or structures supported by retaining walls before demolishing them.

Barricade the area below **floors** that workers are removing to prevent access. Place warning signs around the perimeter. Use a plank at least 2 in (5 cm) thick and 10 in (25.4 cm) wide for standing support while breaking down floor sections between beams or joists. The planks must provide safe support if the joists between the beam collapse. The straddle space between planks must be less than 16 in (40.7 cm).

People should not walk on exposed beams. Create walkways made of wood planks that are at least 18 in (45.7 cm) wide and 2 in (5 cm) thick and that overlap by at least 1 ft (0.3 m). Stringers must support the flooring planks, and their ends must be supported by floor beams or girders.

Provide safe planking for workers to stand on if floors or portions of them are gone while they are dismantling the **steel components**. Safely lower structural steel. Do not drop it unless it will fall into a barricaded or fully protected dump zone. Secondary debris can be created from dropping large and heavy structures. Install proper support, such as shoring, on floors before erecting derricks, cranes or other lifting devices. Hook steel components to the center of gravity to prevent swinging during movements, and use tag or guide lines for additional control.

Other structures that may be part of demolition work include fences, parking lots, lighting, road access, sidewalks, stairs, utilities, storage tanks and equipment. Determine what chemicals or materials were stored inside tanks and vessels before you remove them. If the contents were hazardous, use appropriate control measures. Dispose of hazardous materials according to state and local jurisdictions, which prohibit using general landfills. Clean, purge and verify that previous feed and discharge lines are disconnected and isolated before any work begins. If workers must enter tanks and vessels, use a permit-required confined space entry program specific to each space that workers must enter.

Mechanical Demolition

Mechanical demolition involves knocking structures down using equipment. Only authorized, necessary workers are allowed in mechanical demolition areas. Mechanical demolition is only allowed when the distance to publicly accessible areas is greater than 1/4 of the height of the structure or when appropriate perimeter protection is in place.

Workers must operate **mechanical equipment** using the manufacturer's instructions. Equipment operators must wear respiratory protection. Equipment booms must be able to extend at least 5 ft (1.5 m) above the structures they are demolishing. Ensure that equipment outriggers are properly leveled on ground that will provide adequate support.

The project owner must approve the use of **swinging demolition balls**. They may be required to obtain additional permits and insurance before use. A competent person must inspect the equipment, including rigging, at least once every shift.

Blasting

Blasting involves strategically placing and detonating explosives to make a structure collapse into itself rather than out. Explosives will vary, depending on a structure's size and age and the blast configuration.

Only a qualified, authorized and licensed person may handle explosives and use them for blasting. Some locations call this person the **certified blaster**. Being a certified blaster on blasting operations requires special training.

Some of the hazards from blasting operations include fragmentation; dust, smoke and fumes; vibrations/shock waves; secondary fires; and loud noise.

Certified blasters must consider where **debris** is projected to fall and land in every direction. Structures must have vacant land in all directions that is equal to at least 75% of their height, unless the certified blaster can demonstrate or prove consistent performance with tighter constraints.

The certified blaster must develop a **plan** that is approved by authorities that have jurisdiction, such as fire marshals or government designated authorities (GDAs).

Demolished smokestacks, silos or similar structures must fall at a 90° angle onto a vacant space that is at least 150% of the height of the structure.

A **blasting mat** is usually made of sliced-up rubber tires that are bound together with ropes, cables or chains. Blast mats help to contain the blast, prevent flying rocks and suppress dust when demolishing bases, foundations, piers, abutments or similar structures.

Every demolition can teach us about safe operations for future projects. Conduct an **after-action review** following the use of explosives to document lessons learned.

Personal Protective Equipment (PPE): Head Protection

By wearing appropriate head protection, you can avoid head injuries that can be life-changing or fatal.

Hazards
Wear head protection when your employer or jobsite requires it. Your employer may communicate head protection requirements on signs at entrances to work areas, in job hazard analysis forms, risk and hazard assessment forms and safe work procedures and during training, pre-job briefings and safety meetings. You may also choose to wear head protection as an added precaution or to adapt to changing conditions.

Your head may be injured when it strikes falling items, surfaces, fixed objects or energized objects.

You may be required to wear head protection when you:

- Are in confined areas where (you may bump your head in crawl spaces, vaults and crowded areas)
- Must change elevations or work in excavations, trenches and pits (you may fall, or things may fall on you)
- Have people performing work overhead (materials may fall on you)
- Work near electrical hazards, such as exposed electrical conductors (you could be shocked or electrocuted

Head protection may include hard hats and safety helmets. Bump caps (canvas hats or plastic shells) do not offer standardized protection and are not suitable to protect your head from the hazards above.

Head protection should meet applicable regulatory standards specific to your location.

The hard **outer shell** of the hard hat or safety helmet resists penetration. The **suspension system** absorbs impact. The **material** with which the hard hat or helmet is made may resist water, heat or electrical current. Check the manual and the label to learn about the features of each hard hat or helmet.

Types and Classes
Hard hats are often divided into two types and three industrial classes. The United States and many other countries use the American National Standards Institute (ANSI) classification system. **ANSI type 1** head protection protects wearers from impacts to the top of the head. **ANSI type 2** head protection protects wearers from impacts to the top AND sides of the head and has more impact absorption than Type 1.

General head protection provides good impact protection but offers limited voltage protection. It is for general service activities, such as mining, building construction, shipbuilding, forestry and manufacturing where we do not expect electrical exposure.

Electrical head protection provides limited protection against falling objects and shock and burns. Workers wear electrical head protection when they perform electrical work, such as utility services.

Conductive head protection is lightweight and designed for comfort, but it offers limited impact protection and no electrical protection.

The risk assessment will determine which head protection to use. Ask your supervisor if you have any questions. Check for a label inside the head protection for information about its type, class and features.

Use and Considerations
Do not use head protection as a bucket to carry anything, as a support to set things on, as a seat or as a vehicular or sports helmet.

Make sure to use approved accessories that do not compromise the safety elements of the head protection.

Do not modify head protection by puncturing, engraving, marking or painting it. Avoid applying unnecessary stickers or decals on general and conductive head protection and never apply them on electrical head protection.

Only use **accessories and attachments** that are approved by the manufacturer and the risk assessment. Examples of head protection attachments include cold-weather liners, sweat bands, sun shields, padding, headlamps, earmuffs and face shields. Makeshift or unapproved accessories and attachments can reduce the effectiveness of head protection, such as reducing impact absorption, fit or vision. Check the head protection manual and label and ask your supervisor if you have questions about which accessories and attachments are acceptable and how to install them.

Before you put head protection on, check the manual and the label to determine how to wear and adjust it. Make sure the head protection is **oriented** correctly; the bill should be forward unless the label indicates otherwise.

Fasten the suspension system according to manufacturer instructions. Sweatbands should cover the forehead portion of the headband. Adjust the head circumference fit. The head protection should feel secure but not painfully tight. The head protection should not damage your skin; damage or pain indicate it is not sized properly. Wear a chin strap to prevent the head protection from slipping or being bumped off.

Care
Inspect all components of head protection before each use. Look for signs of damage, such as dents, cracks or penetration. Headbands should be free of wear and stretching. The outer shell should be free of chalking or flaking and any gloss should be intact. These signs indicate damage caused by heat, chemicals, sunlight or radiation.

If you find any defects or damage, follow your company's procedures to report the issue and remove the head protection from service. If head protection sustains a heavy blow, remove it

from service. Follow the manufacturer's instructions regarding the frequency with which to replace head protection, their shells and suspension systems.

Regularly clean your head protection. Dirt can hide defects, and chemicals can damage components, making them weaker and reducing or negating their electrical resistance. Check the manual or label for instructions about how to clean head protection. Carefully inspect head protection after cleaning.

DO:

- Keep head protection clean and dry
- Store head protection away from damaging conditions
- Use designated racks or manufacturer-approved storage hooks
- Keep storage bags clean and uncontaminated

Do NOT:

- Store head protection in direct sunlight or hot areas/vehicles
- Shove head protection in toolboxes
- Store head protection with the shell side down (may collect contamination/debris)

Blasting Area Awareness

Workers use explosives and blasting agents in construction. It's important that the people who work on sites that have blasting know the hazards, process and what to do in emergencies.

Hazards
Flyrock is any object that travels outside the blast area. It can weigh from a few ounces to several tons. Flyrock can travel very far and is responsible for the most serious injuries on sites where blasting occurs.

Flyrock is a concern for EVERYONE on blast sites, not just those near the explosion.

Other blasting site hazards include:

- Noise
- Vibration
- Pressure waves
- Heat
- Fumes
- Dust

The closer you are to the blast, the greater the risk of these hazards.

Planning
The blaster-in-charge will communicate the blasting plan to site personnel and will conduct a pre-blast meeting to go over:

- When a blast will occur
- Number of blasts planned
- Signals prior to and after a blast (all-clear)

Working near where blasting personnel prepare charges can cause premature detonation.

Immediately follow any instructions you receive from the blaster-in-charge or guards.

Signs
Signs may indicate blasting procedures, warning signals and may also warn personnel about blasting activities:

- BLASTING ZONE AHEAD: the road or path leads to a blasting zone
- TURN OFF TWO-WAY RADIOS AND CELL PHONES: turn off devices that could cause a premature detonation
- END BLASTING ZONE: indicates the terminating edge of the blasting zone

The blaster-in-charge or authorized agent will cover or remove the signs when no explosives are in the area or explosives are otherwise secured.

Blasting procedure signs tell you what different signals that the blasting crew will use mean.

Signal Systems, Barricades and Guards

Signal systems must:

- Be audible, simple and understood by EVERYONE
- Include at least two warnings prior to a blast (preferably with sirens or horns)
- Include an "all clear" signal when the area is safe again

Barricades and guards control the flow of traffic into and through the blast zone.

Re-Entering the Site

Silences does NOT equal safety! A **misfire** is a charge that does not detonate or only partially detonates. A **hangfire** explosion is a blast that occurs after the blaster-in-charge expects it to happen.

The blaster-in-charge will conduct a post-blast inspection.

Wait for the "all clear" signal to re-enter the blast site.

Emergencies

Expect that the blaster-in-charge may suspend operations due to:

- Severe weather
- Unauthorized personnel on-site (report to your supervisor immediately)

If you see someone ignore warning signs and go into an unsafe blasting area, alert your supervisor immediately.

Excavation and Trenching Safety

Excavation and trenching work is performed thousands of times daily, in all types of conditions. Increasing your awareness of the hazards associated with excavation work and understanding the laws, regulations, and company safety policies and procedures associated with your work will help keep you safe.

Soil Dynamics

- Soil is extremely heavy. It can weigh more than 100 pounds per cubic foot, and a cubic yard may weigh more than 2,700 pounds (1,600 kilograms per cubic meter)
    - That is more than 1 ton, the equivalent weight of a pickup truck, in less space than an average office desk!
- A collapse doesn't have to completely cover a worker to be fatal
- The typical point of failure in most excavations is within the bottom third of the excavation. Under pressure from the soil above, this part of the wall will break off from the side wall. This creates an undercut area at the base of the excavation. Gravity then brings down overhead soil

Soil Conditions

- **Moisture** plays a major role in the cohesiveness of the soil. Hazardous soil conditions can be created by having either too much or too little moisture. Weather conditions change soil stability. Do not go into trenches or excavations if water has accumulated or is freely seeping in
- **Vibration** caused by construction operations or nearby traffic can also change soil stability
- **Weight** from equipment, excavated soil or other materials can contribute to collapse if placed near the unsupported face of an open excavation or trench
    - Soil, tools and materials must be kept at least 2 feet (.6 meter) from the excavation or trench edge
- **Loose material** that is subject to falling should be removed from the side walls
- Remove or support large items near the excavation (e.g., sidewalks, buildings)
- Soil is classified as stable rock, Type A soil, Type B soil and Type C soil, or combinations of these four classifications. The A, B and C classifications relate to the cohesiveness of soil
    - **Type A** (the most cohesive) is mostly stable, usually consisting of clay, silty clay and hardpan
    - **Type B** soils can consist of previously disturbed soils, except those that would be classified as Type C, or soil that meets strength requirements of Type A but is fissured or subject to vibration. Type B soil has medium stability and can consist of silt, sandy loam, medium clay and unstable dry rock
    - **Type C** soil is the least stable and can contain sand, gravel and soft clay. It can consist of submerged rock or soil or soil freely seeping water

Protective Systems

- **Sloping** and **benching** are protective measures that cut the walls of an excavation back at an angle to its floor. The angle is determined by the soil classification. Generally, the flatter the angle, the wider the excavation at the top and the greater the protection provided for workers
    - Sloping ratios:
        - Type A – ¾ to 1
        - Type B – 1 to 1
        - Type C – 1½ to 1
    - Benching describes a method where soil is stepped back to meet sloping ratios. Benching is not used for Type C because of the instability of the soil
- **Shoring** is a mechanical support system used when appropriate sloping is not possible
- **Shielding** involves cave-in protective structures. Shields used in trenches are often referred to as "**trench boxes**"
    - Trench boxes should extend at least 18" (.5 meter) above the surrounding area to prevent soil, tools or other material from falling on workers
    - The area between the trench box and the face of the trench should be as small as possible to prevent unexpected movement
    - When trench boxes are being installed or moved vertically, no one should be allowed in the trench

Access

- A ladder, stairway or ramp must be located in excavations that are 4 feet (1.2 meters) or more deep
- Workers should not have to walk more than 25 feet (7.5 meters) to use a ladder
- Ladders must be secured and extend 3 feet (1 meter) beyond grade
- When ladders are used with trench boxes, they need to be placed within the box
- If a ramp is used, it must allow workers to walk upright out of the excavation
- Fall protection is needed when an excavation presents fall hazards of 6 feet (1.8 meters) or greater
- Walkways with guardrails must be provided if workers are required or permitted to cross over excavations that are 6 feet (1.8 meters) or greater

Underground Interferences

- Utility companies or owners must be contacted at least 48-72 hours prior to digging so the location of underground line locations can be marked
    - All states have a one-call hotline for this purpose
- Marked locations are approximations of utility locations. Care must be used and the exact location determined by hand-digging or other safe means
- Exposed underground pipe needs to be protected and supported to prevent damage
- Site supervision must be notified if utilities are disturbed
- If you make contact with any underground casing or pipe, have your supervisor contact the utility owner immediately

Competent Person

- Every jobsite that has an excavation should have a "Competent Person." The Competent Person must be capable of identifying existing and predictable hazards and have the authorization to take prompt corrective measures to eliminate problems
- The Competent Person must perform inspections of excavations, adjacent areas and protective systems prior to work start daily and as needed

Hazardous Atmospheres

- Excavations can potentially contain hazardous atmospheres that are oxygen-deficient (less than 19.5% oxygen) or that have accumulation of toxic gases. Unsafe air is usually due to work activities and/or contaminated soil
    - Activities include welding, cutting, application of coatings or adhesives, use of cleaning solvents, abrasive blasting or use of internal combustion engines
    - Contaminated soil may be due to location near past or present oil or gas fields, chemical plants, gasoline stations, landfills, wastewater treatment facilities or other locations where chemical contamination of the soil may have occurred

Emergency Procedures

- Collapse happens quickly. Initial collapses may lead to secondary collapses, making rescue difficult or unsafe
- Call 911 and secure the area. Rescues should be undertaken by specially trained medical or emergency rescue personnel ONLY

Blocking and Cribbing

A lot of work requires the use of lifting tools such as hydraulic jacks, cranes and hoists. Any lifting tool can potentially fail and if you happened to be under a load during such a failure, chances are you would be injured or killed. Never get under raised equipment or components unless they have been properly blocked or cribbed.

- **Blocking** involves placement of wooden blocks, other designated blocking materials, or jack stands under equipment and components to keep them secure and stable while they are raised
- **Cribbing** is placement of a machine or component on alternating tiers of blocks

The support base that cribbing creates is larger than that created by blocking, which offers more stability. This is particularly important for loads above surfaces that are not perfectly firm and level.

Materials and Equipment

- **Oak** is one of the best types of wood for blocking and cribbing because it is particularly hard and able to withstand heavy weight. If they are in good condition, 6-inch by 6-inch (140-millimeter by 140-millimeter) oak blocks can handle extreme weights
- **Soft woods** like southern pine and Douglas fir are sometimes used for blocking and cribbing. They are good for unknown or difficult-to-calculate loads. Soft woods can easily split, chip or weaken under heavy loads, but they have warning signs when they become overloaded
- All blocks used for a job must be the same size for stability
- Inspect blocks before each use
- Look for defects such as splits and rounded edges

Jack stands are appropriate for blocking on firm, level surfaces, such as concrete. Before using a jack stand for blocking, always inspect it for damage to ensure it is in good condition and make sure the jack stand's weight rating is greater than the weight of the load it will need to support. Jack and jack stand load ratings will be legibly marked in a prominent location.

General Precautions

- Always compare the weight rating of your lifting device to the weight of the load and do not exceed lifting device capacity
- Establish and maintain multiple blocking and cribbing support points as necessary for a stable base under raised equipment
- Raise and lower equipment and components slowly from a position of safety.
    - Position yourself so that your body is not under the load
    - Avoid placing your hands between the load and the blocking and cribbing material. Slide the wood into position
- Equipment with functional onboard hydraulic systems may be used to lift equipment so blocking and cribbing can be placed
- Never rely on hydraulics to support attachments

- Whenever possible, move equipment to a place where the ground is firm and level because hard surfaces reduce the likelihood of settling, instability and equipment upset
    - When you absolutely must crib on rough or uneven ground, you need to level out the machine in a safe manner

Safety Principles

Cribbing When Lifting by Jacking Stages

Whenever possible, you should place a jack on a hard surface, such as concrete. Jacks can also be placed on blocks on the ground. If you must, you can use cribbing to lift by jacking stages:

- Put as many tiers of cribbing as possible under the load before you lift it
- Build a crib for the jack, high enough for the jack to extend enough to lift the load
- Create a platform for the jack out of hardwood timbers. Place the platform in the center of the cribbing and make sure it provides a base at least one and half times as wide as the jack's footprint
- Place the jack on the platform and use the jack to lift the load enough so you can add an additional tier to the cribbing under the load; add the tier
- Repeat this process as many times as necessary

Cribbing on Rough or Uneven Terrain

When you absolutely must crib on rough or uneven ground, you need to level out the machine. The precise method you should use will depend on the exact nature of the terrain. You may not be able to determine exactly what you will need to level the machine until you are on-site, so bring plenty of equipment.

Load Securement for Heavy Equipment

The North American Cargo Securement Standard was designed to ensure cargo transported on the highway remains on the vehicle carrying it. The Standard applies to commercial vehicles in the United States and Canada with a gross vehicle rating over 10,000 pounds (4,500 kilograms). It requires all cargo to be contained, immobilized or secured so it does not fall from or blow off the vehicle, leak, spill or shift so much that the vehicle's stability or handling is impaired.

Force Requirements
The securement requirements are based on the amount of forward, backward, sideways and upward force cargo is actually likely to experience.

- Cargo experiences the most force in the **forward direction**. This force is created from braking while driving straight ahead. In order to counteract this force, the securement system must be able to withstand force equal to 80% of the cargo's weight in the forward direction
- Cargo experiences a significant amount of **backward force** from activities such as accelerating, shifting gears while climbing a hill, or braking while backing. So, the securement system must be able to handle force equal to 50% of the cargo weight in the rearward direction
- When a vehicle turns, changes lanes or brakes while turning, a significant amount of force pushes cargo to the side. So, the securement system must be able to restrain **sideways force** equivalent to 50% of the cargo's weight
- Cargo experiences some **upward force** when the vehicle hits a bump or crests over a hill. So, the securement system must be able to withstand force equivalent to 20% of the cargo's weight

Securement Systems
A securement system involves three elements: vehicle structure, securing devices, and blocking and bracing equipment.

Vehicle Structure
Vehicle structural elements include

- Floors
- Ramps
- Anchor points

Before loading heavy equipment on a trailer, inspect each structural element. The vehicle's structural elements must be able to support the weight of the equipment as well as forward, backward, sideways and upward forces of the equipment and securement system. To stay within the load limits, always consult the manufacturer's vehicle specifications. Never load a vehicle with more weight than the manufacturer recommends.

Securing Devices
A securing device is designed to attach or secure cargo to a vehicle or trailer. Securing devices include, but are not limited to, chains, binders, hooks, clamps, latches, blocking and bracing. We must use a combination of devices to form tiedowns and secure the load.

Tiedowns are securing device assemblies that attach to one or more anchor points and secure the cargo.

Blocking and Bracing
Heavy equipment can potentially split or crush inadequate securement materials. Make sure sufficiently strong materials are used for blocking, bracing, chocks and cradles. If you use wood materials for blocking and bracing, use hardwoods and make sure the wood is properly seasoned and the grain runs lengthwise.

Inspect the wood to make sure it is free from:

- Rot
- Decay
- Knots
- Knotholes
- Splits

Loading and Unloading
Loading
Before you load heavy equipment, check the vehicle and trailer. Complete a walk-around inspection, looking for any damage or leaks. Keep the weight of the equipment evenly distributed and aligned on the trailer. Get in the truck and put on your seat belt. Check the condition of the brakes. If they're good, start the engine and drive the machine to the trailer.

Do NOT proceed onto the trailer until you and the driver have made eye contact and signaled your readiness to each other.

Once the machine is properly loaded, lower all attachments or implements. Set the parking brake and shut off the machine. Chock the wheels and tie down the machine to prevent it from rolling. Be on the lookout for **low-friction situations**, such as metal tracks on a metal trailer, or at the breaking point, which is usually at the point where the trailer and ramp meet.

During the loading process, be sure to keep the weight of the equipment evenly distributed front, rear, and side to side on the trailer. Keep in mind you may have to back the equipment on the trailer if the attachments are wide enough to block or reduce the driver's visibility. When loading equipment on high trailers, it may be best to back the trailer up to a dock of equal height and load the equipment that way or lower the rear of the trailer to ground level, if possible.

Unloading
When receiving heavy equipment, you should complete an initial inspection before unloading it. Look for any water or oil leaks and check the overall condition of the equipment. Low friction means low traction. Go slowly and anticipate wheel or track spin. Immediately reduce power at first indication of spinning to prevent side shifting that can send equipment off the side of the trailer.

Receiving
When receiving heavy equipment, you should complete an initial inspection before unloading it. Look for any water or oil leaks. Check the overall condition of the equipment. Talk to the

driver to gather any additional information about the equipment. If the equipment is new or a rental, make sure you identify any damages and document them on the bill of lading.

Tiedowns
There are two types of tiedowns. As the name indicates, **direct** tiedowns attach directly to the cargo and provide direct resistance to outside or external forces. **Indirect** tiedowns pass over or through the cargo, generating downward force increasing the friction between the cargo and the deck.

You must attach and secure tie-downs so they won't loosen, unfasten, open or release during transit. If rub rails are present and the load is sufficiently narrow, you must place all tiedowns within the rub rails. If tiedowns could potentially be cut or torn by cargo contact, you must use edge protection. Edge protection must be resistant to crushing, cutting and abrasion.

The strategic placement of properly rated tiedowns helps you meet the "force" standards, which counteract any forward, backward, side-to-side and vertical movement of the cargo. When you secure a front-end loader weighing approximately 20,000 pounds, the securement system should be capable of withstanding:

- 80% or .8 g forward force of 16,000 pounds
- 50% or .5 g rear and sideways force of 10,000 pounds each
- 20% or .2 g upward force of 4,000 pounds

You determine the number of tiedowns according to the weight of the equipment and the rated strength of the tiedown. A **working load limit**, or WLL, is the maximum load that can be safely applied to a securement system component. A tiedown's WLL is only as great as the smallest WLL among its parts and the anchor points to which it is attached. The securement system must have a WLL equal to at least half the weight of the cargo it secures. If you need to eliminate cargo movement completely, use greater tiedown capacity.

A minimum of 4 tiedowns must be symmetrically attached to the front and rear of the equipment or to mounting points on the equipment. Ideally, the angle of the tiedown should be less than 45 degrees for direct tiedowns and greater than 45 degrees for indirect tiedowns. Additional tiedowns may be needed.

The combined WLL of all the devices used to secure cargo is called the **aggregate WLL**. A securement system's aggregate WLL must be at least half the weight of the cargo it secures. Suppose a machine weighs 40,000 pounds and each tiedown has a working load limit of 4,000 pounds. The aggregate working load limit of the securement system must equal at least 50% of 40,000, which is 20,000 pounds. If you divide 20,000 pounds by 4,000 pounds, you'll see you need 5 tiedowns to give you the aggregate working load limit of 20,000.

Before the driver attaches the tiedowns, the heavy equipment operator must lower the equipment's attachments or implements to the deck of the trailer. If the accessory device is designed to be transported in a raised position, or if the device extends beyond the width of the trailer, secure the accessory equipment with a locking pin, locking device or a chain.

Loads exceeding 8.5 feet (2.59 meters) in width are **oversized loads**. Equipment this large may present overweight issues. Refer to provincial or state-specific requirements concerning permits, flagging, warning lights, escort vehicle and other transportation considerations.
When attaching the tiedowns to the equipment and vehicle's anchor points, remove all twists, kinks and slack from the chains to prevent the tiedowns from loosening or coming unfastened during transit. Use your own strength or the proper leverage bar to tighten tiedowns. Do not use a pipe or cheater bar, which can slip.

Inspections
The driver must inspect the cargo and securing devices before driving, within the first 50 miles (80 kilometers), whenever the driver's duty status changes, and at 3-hour intervals or every 150 miles (240 kilometers), whichever comes first. If the cargo is in danger of shifting or falling, the driver should adjust the securing devices, add additional securing devices or perform a combination of these adjustments.

Concrete and Masonry Awareness

NOTE: You need qualified professionals to coordinate technical safety matters beyond the scope of this course.

General Safety Requirements

Topic	General Safety Requirements
Construction loads	– Do not place construction loads on new concrete surfaces until a qualified person certifies them to carry the weight – Qualified persons are typically engineers with civil or structural engineering credentials
Reinforcing steel	– All protruding reinforcing steel must be guarded to prevent impalement – Prevent unrolled wire mesh from recoiling (secure each end of the roll or turn the roll over)
Post-tensioning operations	– The sudden release of energy from failed tendon cables, anchorages and tensioning equipment presents severe risk to personnel (recoiled cables, projectiles, etc.) – Place signs and barriers to keep non-essential personnel away – Areas behind tensioning jacks and dead-end anchorages are the most severe danger areas – No one should ever be in-line with cables being tensioned
Working under loads	– Do not work under objects moved or supported by cranes (includes concrete buckets and pre-cast concrete panels)
Personal protective equipment (PPE)	– Wet concrete is a skin/eye irritant – Remove wet or saturated clothing – Immediately rinse your skin and eyes – Seek immediate medical attention for eye contact – Be prepared for splashes when working with concrete slurries – Wear protective boots, gloves and eye protection (coveralls when practical)
Power concrete trowels	– Verify that power concrete trowels and other manually guided powered and rotating equipment have control switches to automatically shut down power when the operator's hands are removed from the handles
Concrete buggies	– Handles must not extend beyond the wheels on either side
Tremies/Hoppers	– Secure with wire rope in addition to regular connections
Bull floats	– Non-conductive or insulated handles reduce risk of electrical shock
Masonry saws	– The guard with a semicircular enclosure over the blade is designed to retain blade and material fragments – Dust suppression systems limit exposure to silica dust
Lockout/Tagout	– Do NOT service equipment unless it is properly locked out and tagged – Tags must read "DO NOT OPERATE" or similar

Cast-in-Place and Pre-Cast Concrete

- Formwork must be able to support all vertical and lateral loads
- Placement and rate of pour must be consistent with design (excessive rate of pour can overload forms)
- A qualified person will develop/update plans and drawings, which will be accessible at the jobsite

Shoring and Re-shoring Systems
Shoring and re-shoring systems must be:
- Designed by a qualified person
- Set in firm contact with surfaces supported
- Inspected prior to, during and after concrete placement
- Immediately reinforced if damaged or weakened

Vertical Slip Forms
Vertical slip forms are forms that we move upwards during continuous pours to create tall structures such as bridges, towers, buildings and dams.

Reinforcing Steel
Reinforcing steel for vertical structures must be adequately supported to prevent overturning and collapse.

Scaffolds and Work Platforms
- Fully planked walkway systems along the upper level of formwork include guardrails to prevent falls
- Use a fall arrest system for any work outside the guardrail systems
- Protect lower level walkways from falling materials
- Workers must leave walkways before slip forms are moved

Formwork Removal
- Employers determine if the concrete is strong enough to support their weight/load
    - Plans and specifications give conditions
    - The concrete has been properly tested
- NEVER remove re-shoring until the concrete has strength to support weight/loads

Lifting Operations
IMPORTANT: Dropping or losing control of lifted panels and other pre-cast members can result in severe injuries or death. Workers who aren't needed to lift, move and secure panels must keep away from the lifting area.

Workers involved in lifts must take precautions to avoid pinch/crush hazards:
- Avoid being under a panel while it is being tilted
- Avoid being on the blind side of the panel while the crane is traveling with it
- Avoid being between the crane and the panel
- Avoid reaching between the panel being lifted and an adjacent panel
- Avoid reaching under panels to adjust shims and bearing pads
- Avoid the release of lifting lines prior to bracing completion
- Use taglines to guide pre-cast panels and help the ground crew avoid pinch/crush areas
- Make sure qualified crane operators/riggers verify lifting equipment condition and capacity
- Suspend lifting operations in strong wind, heavy rain and other adverse weather conditions

A Qualified Person will:

- Determine if embedded or attached lifting inserts and hardware are of sufficient capacity
- Verify when onsite castings have achieved sufficient strength
- Decide if slab foundation/footing has capacity for pre-cast loads and weight of cranes operating on the pad
- Verify that temporary base restraints are in place to prevent kick-out
- Ensure that panels remain braced/supported until permanent structural connections are complete

Masonry Construction
Limited access or exclusion zones:

- Are established by employers prior to the start of masonry construction
- Restrict access to only workers actively engaged in constructing the wall
- Stay in place until walls higher than 2.4 meters (8 feet) are adequately supported

The limited access or exclusion zone must:

- Be equal to the height of the wall to be constructed plus 1.2 meters (4 feet)
- Run the entire length of the wall
- Be on the side of the wall that will not be scaffolded
- Be marked by barricades and signs that say: "Keep Out – Limited Access Zone"

High Winds

Masonry walls are particularly vulnerable to wind loading while under construction. In high winds (48-64 kilometers or 30-40 miles per hour), immediately evacuate scaffolding and the danger area, including the limited access zone.

Stacking and Storage Practices for Construction

When you are moving and storing materials at a construction site, there are a number of things that can go wrong, resulting in injuries like splinters, cuts, scrapes, or crushed fingers, hands and feet – and even death.

Potential Hazards
Workers can be injured by:

- Falling objects
- Improperly stacked materials
- Equipment and materials that may be sharp, abrasive or heavy

When manually moving materials, be aware of potential injuries such as:

- Strains and sprains
- Fractures and bruises
- Cuts and bruises

Moving, Handling and Storing Material
You should seek help moving a load when you cannot: properly grasp, lift or control it; see around or over it; or safely handle it.

Best Practices

- Ensure that NO part of the body is under a raised load
- Blocking materials should be large and strong to support the load
- Use handles or holders and tag lines to reduce finger pinching or smashing
- Use personal protective equipment (PPE):
    - For loads with sharp/rough edges, wear gloves/hand and forearm protection and eye and face protection
    - When loads are heavy or bulky, wear steel-toed safety shoes or boots
- Do not stack or store ANY materials closer than 18 inches (45 centimeters) from sprinkler heads

When moving materials with mechanical equipment:

- Avoid overloading equipment
- Note the equipment-rated capacity on each piece of equipment
- Pay attention to ground conditions
- Consider other employees near the path of travel

When using rough-terrain lifts, telehandlers and powered industrial trucks, the load must be:

- Centered on the forks
- As close to the mast as possible
- At or below capacity; never overload a lift truck
- At the lowest position for traveling
- Correctly piled, if stacked

Stacking Materials

Material	Best Practices
Lumber	• Remove nails before stacking • Stack and level on solidly supported bracing • Should be stable and self-supporting
Bricks	• Stacks should be no more than 7 feet (2 meters) high • Taper back 2 inches (5 centimeters) for every foot (30 centimeters) of height above 4 feet (1.2 meters) • Taper masonry blocks back 1/2 block for each tier above the 6-foot (1.8-meter) level
Bags and bundles	• Stack in interlocking rows to remain secure • Stack bags by stepping back the layers and cross-keying the bags at least every 10 layers
Boxed materials	• Band or hold in place using cross-ties or shrink-wrap
Drums and barrels	• Stack symmetrically • If stored on sides, block bottom tiers • When stacked on end, put planks, sheets of plywood or pallets between each tier to make a firm, flat stacking surface • When stacking materials two or more tiers high, chock the bottom tier on each side to prevent shifting in either direction
Hazardous materials	• Some cannot be stored together; check with your supervisor or general contractor if you are unsure
Combustible materials	• Store away from areas in which workers are welding or doing hot work
"Unstackable" materials	• Unstackable materials (due to size, shape or fragility) may be safely stored in cargo containers or bins
Cylindrical materials	• Example: structural steel, bar stock, poles • Stack and block
Pipes and bars	• Do not store in racks which face walkways

Materials Handling Practices for Construction

To reduce incidents associated with workplace equipment, employees need to be trained in the proper use and limitations of the equipment they operate.

Cranes
Only trained and qualified or certified people may operate cranes.

Operators need to know what they are lifting, what it weighs, and the intended path of travel. For example, rated capacity of mobile cranes varies with the length of the boom and the boom radius. When a crane has a telescoping boom, a load may be safe to lift at a short boom length and/or a short boom radius, but may overload the crane when the boom is extended and the radius increases.

Everyone working on a site that has a crane must keep the following guidelines in mind:

- Do NOT pass under loads or place any of your body parts where they may be crushed or pinched
- Make sure you are qualified to signal crane operators
- Use a tag line to guide loads
- Keep people away from fall hazards when loads are received at elevations
- Exclude general site workers from the fall zone where hooking/unhooking loads are taking place. These areas are limited to authorized employees who are directly involved with hooking and unhooking loads.
    - A fall zone is the area (including but not limited to the area directly beneath the load) where it is reasonably foreseeable that partially or completely suspended materials could fall in the event of an accident.
- Help watch for dangers such as winds, storms and power lines
- Do not use cranes in severe weather conditions
- Stay out of the swing radius of the counterweight

Slings
When working with slings, rigging or other materials-handling equipment, knowledgeable employees must ensure that they are visually inspected before use and during operation, especially if used under heavy stress. Qualified riggers or other knowledgeable employees conduct or assist in the inspection because they are aware of how the sling is used and what makes it unserviceable.

Remove damaged or defective slings from service. Use slings according to the manufacturer's instructions. Store slings in an area where they will not be subjected to mechanical, chemical or ultraviolet damage or extreme temperatures. Do not shorten slings with knots or bolts. Remove kinked sling legs from service. Do not load slings beyond their rated capacity.

Keep suspended loads clear of all obstructions. Crane operators must avoid sudden starts and stops when moving suspended loads. Employees must remain clear of loads about to be lifted and suspended.

Rough Terrain Lifts, Telehandlers and Powered Industrial Trucks

Workers who must handle and store materials often use:

- Fork trucks
- Platform lift trucks
- Concrete buggies
- Other specialized industrial trucks powered by electrical motors or internal combustion engines

Riggers, signal persons, lift directors and equipment operators need hands-on and equipment-specific training about the equipment's safety requirements, design, maintenance and use.

Safety Considerations

Perform a hazard assessment. Use spotters, tag lines and other precautions to maintain the required separation distances between overhead power lines, lifting equipment and loads being lifted.

Watch out for low spots or holes in the driving path. Drive straight up or down a slope rather than diagonally or horizontally to avoid tip-over. Watch out for other workers or equipment near the driving path. Pay attention to areas with limited visibility.

Read the load charts to ensure the load is within the equipment's maximum capacity. Balance the load. Avoid carrying the load too high.

If equipped with outriggers, verify they are placed correctly and securely cribbed to prevent settling.

Slings are not allowed to be attached directly to the forks of a forklift/telehandler (commonly referred to as free rigging).

Restricted Access Zones (Fall Zones)

For activities such as crane lifts or utilizing a telehandler to move materials, restrict access to the fall zone. Only authorized employees are allowed access inside the fall zone. Barricade or rope off the swing radius of the crane. Block off areas below overhead material loading and unloading to limit possible exposure to falling materials.

Materials handling at elevated heights brings additional risk to workers, such as:

- Using trash chutes for material disposal
- Stacking material overhead
- Removing scrap bulk material
- Walking in areas that are not covered or protected from falling materials

Safety and Health

Ergonomics

Ergonomics not only improves jobsite safety but also makes performing certain tasks easier. Ergonomic principles for materials handling may require controls to mitigate stresses and strains on the body. Such controls include:

- Reducing the size or weight of the objects lifted

- Arranging material delivery to reduce carrying distance
- Using forklift rather than manually moving materials
- Moving concrete using a pumper truck or concrete buggy

Lifting

Back injuries and lifting injuries CAN BE PREVENTED by:

- Training employees in appropriate lifting techniques
- Using proper materials-handling equipment on the jobsite

Before lifting:

- Size up the load and where you need to carry it
- Get help if you need it
- Consider using a dolly, cart, wheelbarrow or other assistance in moving heavy materials long distances

When you lift a load manually:

- Bend your knees to avoid stooping over
- Do not jerk or pull at the load
- Keep the load close to your body
- Move your feet when you pick something up or set it down
- Do not twist your body

Additional factors to consider:

- Can I get a good grip on the load?
- Is the item wet? (wet bags of soil can increase their weight by nearly 50%)
- Is the item covered with dust or any other material that could limit a strong grip?

Avoid the risks associated with moisture or dust by:

- Covering the material with polythene sheets when delivered to the site
- Using straw-filled matting and polyurethane foam to protect materials from the effects of frost and snow
- Using a dry goods storage area to protect the material from bad weather

Rough Terrain Forklift Safety - Part 1: Readiness

Rough terrain forklifts are complex machines that require careful preparation to ensure worksite safety. They have:

- Forks to lift loads from the bottom
- Vertical mast
- Pivoted variable/fixed boom
- Cab with overhead guards
- Combustion engine
- Tires for rough terrain
- Variety of steering modes

Personal Readiness and Training

Many regulators require hands-on training for rough terrain forklift operators. During hands-on training, you will learn about specific equipment:

- Operating controls
- Labels
- Warnings
- Capabilities and limitations
- Manuals and standards
- Jobsite hazards

Operators should be rested, alert and free of impairment (medications, alcohol, drugs, etc.).

Area Readiness

Survey the area and identify, mark and address potential hazards:

- Low overhead clearances are collision hazards you should identify and avoid
- Power lines are collision/electrical hazards
    - Minimum 3 meters (10 feet) approach to 0-50KV lines
    - >50KV require more distance
    - Use flag lines and spotters
- Soft soils, unprotected drop-offs and obstructions/debris are tipping hazards
    - 0.6 meters (2 feet) separation from edges/obstructions (mark or barricade)

Weather

Gusty or sustained winds are tipping hazards that may cause load swing and dangerous side loads. Suspending lift operations is required when wind speeds ≥ 24 kph (15 mph, 13 Knots).

Wet, dark or foggy conditions reduce visibility (increasing risk of collisions) and require operating at slow speeds or suspending operations.

Additional Hazards

- Plan lifts during low traffic periods, barricade lifting areas, and assign signalers to avoid collisions with pedestrians/vehicles
- Use equipment that is specially approved for flammable or combustible atmospheres to avoid explosions
- Ensure adequate ventilation and avoid idling the engine in enclosed areas to prevent carbon monoxide poisoning

Critical Lift Plans

Work with your supervisor or safety professionals to develop critical lift plans if you cannot resolve hazards or you have other serious concerns.

Equipment Readiness
Inspect equipment at least once each day and follow your company's procedures for inspection and documentation. **Immediately remove equipment from service and report damages and unsafe conditions.**

During visual inspection of the rough terrain forklift, check for:

- Damage
- Fluid leaks
- Loose or missing parts
- Cracked or bent forks
- Illegible load charts and labels
- Improper tire condition and pressure

Perform operational inspections on firm, level ground that is away from hazards. Slowly test controls and functions:

- Horn, backup alarm, mirrors, lights
- Lift and tilt systems
- Load-engaging means
- Boom angle and chassis level indicators
- Brakes and steering

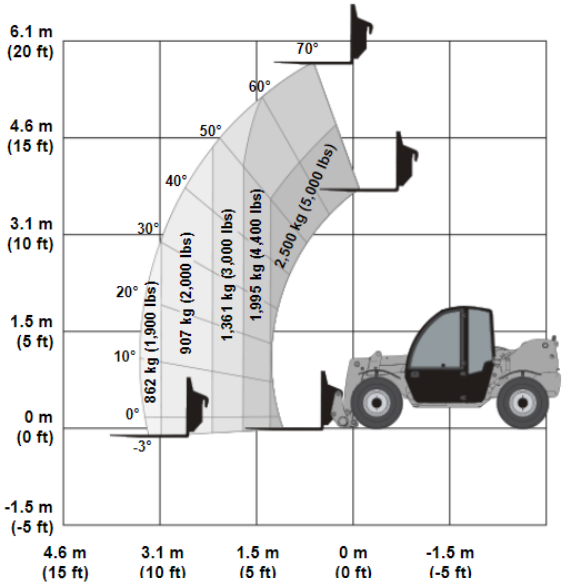
Load Capacity
Overloading is a common cause of tip-overs. The load capacity is the amount of weight a rough terrain forklift can lift safely when:

- On firm ground with the frame level
- Forks are positioned evenly on the carriage
- Load is centered on the forks
- Proper size tires are properly inflated
- Lift is in good operating condition

The equipment may tip if it is deficient in ANY of these aspects.

Using a Load Capacity Chart

1. Determine weight of the load you plan to lift.
2. Determine the location at which you want to place the load:
    - Use the X-axis to find the HEIGHT at which you will place the load
    - Use the Y-axis to find the DISTANCE from the front tires to where you will place the load
3. Find the point at which the height and distance meet.
4. Determine the limits of the load zone:
    - The load zone in which the height and distance meet is the maximum weight capacity for the lift
    - If the height and distance cross at a division between zones, use the smaller number



SAMPLE – DO NOT USE

IMPORTANT: The number in the load zone must be greater than or equal to the weight of the load to be lifted.

Rough Terrain Forklift Safety - Part 2: Operation

Improperly prepared and operated rough terrain forklifts can result in collisions, tipping and losing loads.

Starting the Rough Terrain Forklift
Before starting the rough terrain forklift shift to neutral, set the brakes and fasten your seat belt.

Avoid Collisions
As you move:

- Look in the direction of travel
- Be aware of where your view is obstructed
- Travel with the load trailing or use a spotter
- Slow down and sound the horn at intersections and when your vision is obstructed
- Ensure adequate clearance for rear tail and front fork swing
- Stay inside of the operator's compartment (avoid being pinned/crushed)
- Do NOT stand or pass under parts of the rough terrain forklift
- Heavy loads dropped from a distance may injure you, even in the cab

Preventing Tip-Overs
Tip-overs may be more likely due to:

- Unstable surfaces
- Rocks
- Potholes
- Load or boom raised
- Operating near capacity

Under- and over-inflation increase risk of tire failure and tip-over. Maintain manufacturer recommended tire air pressure.

Slopes and Grades
When **loaded**, travel with the load upgrade. When **unloaded**, keep load-engaging means downgrade.

When you ascend or descend a grade:

- Keep loads low and tilted back
- Downshift to a lower gear
- Engage four-wheel drive

To prevent tip-overs, **avoid:**

- Speeding
- Abrupt movements/braking
- Tight/fast turns
- Turning on slopes
- Driving with the load raised

If the rough terrain forklift begins to tip:

1. Brace yourself.
2. Lean away from the impact.
3. Stay in the cab.

Lifting

Before lifting, consult the manual, load capacity chart, and data plate for safe lifting practices and load capacities for the rough terrain forklift you will operate.

Before lifting:

1. Stop on a stable surface.
2. Set the parking brake.
3. Shift the transmission into neutral.
4. Level the forklift.
5. Lift the load.

Leveling

Use leveling functions and outriggers to improve stability, if possible.

Lifting without leveling leads to tip-overs.

Never make leveling adjustments with the load raised.

Watch for changes in footing or shifting conditions.

After the load is in the air, bring the load back down before re-leveling the rough terrain forklift.

Parking

When the lift is complete:

1. Retract the boom.
2. Lower forks to the carry position.
3. Park on a flat surface where you will not block fire aisles, stairways or safety equipment.
4. Place directional controls in neutral.
5. Apply the parking brake.
6. Position forks or attachments flat on the ground.
7. Turn off the engine.
8. Remove the key to prevent unauthorized operation.

Industrial Ergonomics

Most people have had occasional aches or pain from performing work activities. Many have experienced acute back pain or numbness and tingling in their hands. These symptoms are commonly due to ergonomic factors.

Ergonomics Overview

Ergonomics is the study of people's comfort and efficiency in their working environment. The goal of ergonomics is to prevent and reduce work-related injuries and chronic, painful conditions by adapting work to fit the person instead of forcing the person to adapt to the work. Ergonomics offers some general principles that can help anyone but should also be customized to meet individual needs.

The term **musculoskeletal** refers to the muscles and skeleton, including soft tissues, muscles, nerves, bones and connecting tissues, like tendons and ligaments. Musculoskeletal damage often occurs gradually. Damage and pain can begin subtly and get much worse over time. The pain can be chronic or persistent.

There are many different terms for **musculoskeletal damage,** such as musculoskeletal disorder (MSD), repetitive motion injury (RMI), repetitive strain injury (RSI) and cumulative trauma disorder (CTD). You may also hear about specific musculoskeletal damage diagnoses, such as tendonitis or carpal tunnel syndrome. Ergonomic stress is a cause or contributing cause for all these conditions.

To use ergonomics at work, you must recognize potential problems, take action to prevent problems, use ergonomic work practices and watch out for each other.

Recognizing Potential Problems

Risk factors are conditions that cause ergonomic stress and can increase the risk of musculoskeletal damage. Common examples of risk factors are:

- Repetition (same motion over and over)
- Forceful motion (using excessive force or effort to perform a task)
- Stationary positions (staying in one position for too long)
- Awkward posture (bending joints awkwardly or for a prolonged time)
- Contact stress (direct pressure on the body against a surface or edge)
- Temperature (extreme heat or cold)
- Vibration (restricted blood supply due to vibrating equipment)
- Stress (fast pace, inadequate breaks, monotony and poor organization)

Risk factors can occur at work and at home. Some tasks involve multiple risk factors. Combining risk factors increases the risk for musculoskeletal damage. The level of risk for musculoskeletal damage depends on the length of exposure to risk factors, frequency of exposure to risk factors, intensity of exposure to risk factors and physical condition and capabilities of the person.

Identifying symptoms early gives you an opportunity to heal and to make ergonomic adjustments before the damage gets worse. Symptoms of musculoskeletal damage include:

- Decreased grip strength, range of motion and muscle function
- Pain, stiffness and burning sensations, especially in the joints and extremities
- Numbness, tingling and blanching (white fingers or toes)
- Swelling and inflammation

Minor musculoskeletal injuries should heal with adequate rest, over-the-counter medications, hot/cold therapy and gentle stretching and strengthening exercises. Seek medical attention if severe pain occurs after a sudden injury or if pain interferes with your ability to perform daily activities.

Prevention

To avoid musculoskeletal damage, exercise regularly and stretch at least daily; avoid smoking, which increases inflammation; stay hydrated; eat a healthy, non-inflammatory diet; rest injured muscles and joints; and wear comfortable clothing that does not restrict movement or circulation.

Before you begin working, consider your tasks to see if there are things you can do to make work easier:

- Adjust work to a comfortable height, if possible
- Make sure frequently used tools and materials are easy to reach
- Ensure adequate line-of-sight and lighting
- Check to ensure clearance for full range of motion

Before you perform any strenuous activity, warm up by exercising gently, such as by briskly walking for 5 to 10 minutes. After you warm up, stretch to improve flexibility and range of motion. After strenuous activity, cool down by gently exercising again, such as by walking slowly for 5 to 10 minutes. Stretch again after you cool down. If you experience pain while stretching, report it.

Practices

Your supervisor can help you learn about specific ergonomic practices you will need for your tasks, such as lifting techniques, workstation setup and more. One tip that applies to all risk factors is to **take breaks** to relieve the strain on your body.

To avoid **repetition**, break up repetitive tasks with other tasks, use job rotations (multiple workers taking turns) and automate and mechanize tasks, if possible.

For tasks that involve **forceful motion**, use equipment that applies force for you, team lifts and material handling equipment.

When work involves **stationary positions**, use anti-fatigue insoles, shoes or mats; rotate tasks/jobs; and change positions (for example, alternate sitting/standing or use footrests).

To avoid **awkward postures**, avoid bending or twisting at the waist, adjust workstation height (if possible), use reaching tools and assign waist-level places for frequently used items.

To reduce **contact stress**, adjust equipment and desks so that you don't touch edges, pad surfaces and edges, and wear pads such as knee or shoulder pads.

To maintain comfortable **temperatures**, wear warm/cool clothing, choose appropriate gloves and protective equipment, and wear sweat bands and kerchiefs to keep sweat from eyes.

If you use tools that create **vibration**, work in shorter time segments and wear appropriate gloves.

To reduce **work stress**, adjust line and equipment speeds to a comfortable pace (if applicable), allow adjustment time for new/changed work and after absences, and report concerns.

Note: Gloves that are too tight can restrict circulation. Gloves that are too loose may require a tighter grip or may slip or be caught in rotating parts. See your supervisor if you have questions about glove selection and fit.

Responsibilities

To reduce the impact of ergonomic injuries, you should recognize potential problems; use prevention techniques like warming up and stretching; report ideas, concerns and injuries; and watch out for others (offer help and encourage reporting).

To reduce the impact of ergonomic injuries, your employer should create and provide an ergonomics program; assess, address and control ergonomic issues; respond to reporting; provide training, equipment and tools; and implement healthcare procedures.

Early detection and treatment are the only ways to prevent musculoskeletal damage from becoming much worse over time. Report symptoms right away.

When reporting be prepared to describe when the symptoms started, how it feels, where it hurts, when the pain occurs, how long the pain lasts and what motions or activities cause the pain or symptoms.

Report injuries, regardless of where they happened. Avoid exposing injuries to more risk factors. Your supervisor can help you determine how to address risk factors and may also advise you about healthcare options that your employer provides.

Preventing Back Injury

The back protects the spinal cord nerves and anchors the legs, hips, ribs, arms and head. When there are back problems, these connected areas can be affected as well. The opposite is also true; issues with connected parts can stress the back.

How the Back Works

- **Spinal nerves** carry motor, sensory and autonomic signals between the spinal cord and the body
- The **spinal cord** extends from the brain. It has three major functions:
  - Transporting motor information
  - Conducting sensory information
  - Coordinating certain reflexes
- The spine has interlocking bones called **vertebrae** that are held together by the muscles of the back and abdomen, often called core muscles
- Vertebrae are separated by **discs**, which act as cushions

Types of Injuries

Common injuries include:

- Strain and fatigue
- Fractured vertebrae
- Spinal cord nerve injury
- Pressure on nerves
- Tears in discs
- Disc fractures and ruptures
- Weakness

Risk Factors

Conditions that can increase the chance of an injury:

- Aging
- Poor physical fitness
- Body weight
- Strength
- Flexibility
- Physical stress
- Bad posture

Aging

- Degeneration of the spine
- Inappropriate alignment
- Loss of strength

Physical Condition

- Strong and flexible muscles and joints reduce your risk of injury
- Weak ligaments and muscles may cause discs to be susceptible to injury
- Strong core muscles will add extra support when handling objects
- Excess body weight puts extra strain on your back
- Excess body weight can cause damage because the back operates on a 10:1 ratio

Physical Stress

- Unwanted physical strain or pressure put on the body
- Stress may keep our muscles in a state of tension or contraction
- Stressed muscles are more susceptible to strains, sprains and spasms

Bad Posture

Posture is the balance and alignment of your body.

- "S" or curved shape is the natural position of the spine
- Improper posture leads to musculoskeletal problems

Causes of Injuries

Identifying and understanding the following causes can be your best defense in preventing injury.

Overexertion

- You overexert your back when you strain or fatigue it
- Overexertion can compromise posture, lifting technique and balance - all of which can lead to injuries
- Limits for overexertion depend on the individual's risk factors
- Signs of overexertion include spasms and pain
- Don't ignore the physical limitations of the body

Improper Lifting

- Bending over
  - Using only your back muscles strains the back
- Unnatural body position, like reaching above shoulder height
  - Causes tension and overexertion
- Twisting
- Holding objects away from the body's center
- As the object moves farther from the body, the applied weight of the object and necessary exertion increase

Poor Environmental Conditions

Environmental conditions are the physical surroundings and situations. Potential hazards include:

- Path of travel
  - Wet floors
  - Uneven surfaces
- Arrangement of workplace
  - Reaching above shoulders or below knees increases risk of injury

Prevention

The following can prevent a back injury from occurring.

Proper Lifting Techniques

1. Assess the situation: What are you lifting and from where? Is your path clear? Are you ready?
2. Test the weight of the object; if it's too heavy, get help or use a mechanical device
3. Bend your knees. Get a good grip. Tighten the muscles in your arms, legs and abdomen.
4. Look straight ahead. Hug the object. Turn with your feet; don't twist at the waist.

When you lift bagged items, crouch over them with one leg braced and another kneeling. Lean the bag onto the kneeling leg, then slide it up to the braced leg. As you stand, keep the bag close to your body.

Carrying

When you carry items:

- Wear appropriate gloves (gloves with rubber dots may improve grip while loose/thick gloves may make it hard to grip)
- Use handles, grips and handholds, if they are available
- If you use one hand, alternate between left and right
- Pad your shoulders if you carry loads on them

Proper Equipment

- Adjust your workplace (follow principles of good ergonomics)
- Wear comfortable shoes with slip-resistant heels and soles
- Use mechanical aids when lifting heavy or bulky objects
- Get help from a co-worker

Personal Prevention Strategies

- Maintain good posture
  - Don't slump, slouch or hunch over
- Outside work:
  - Exercise
- Sleeping:
  - Use a firm mattress
  - If you sleep on your side, keep knees slightly bent with a pillow between them
  - If you sleep on your back, keep a pillow under your knees
  - Avoid sleeping on your stomach with your head resting on a stack of pillows
- Reduce stress
- Know the facts about back injuries
  - Injuries are cumulative
  - Don't ignore minor back pain
- Before you work and throughout your day, make time to stretch to reduce muscle fatigue and maintain flexibility

NOTE: Stretching should provide muscle relief. If you feel more than a brief twinge of discomfort, or if you feel numbness or tingling, you may have an injury. Do not force movement. Instead, stop and consult a physician.

Strengthening the Back

- Exercises that stretch and strengthen the muscles of your spine can help prevent back problems
- If your back and abdominal muscles are strong, you can maintain good posture and keep your spine in its correct, most natural position
- Do exercises even if you've worked a long day

Injury Response

Most minor strains will go away in time if you stay limber and active. If you suffer an injury or if your back pain includes numbness or tingling anywhere on your body, you should see a medical professional. Remember to:

- Report the injury to your supervisor immediately
- Follow workplace policies regarding medical care and/or treatment
- Follow medical advice about medications, treatment and physical activities

Lifting Technique Checklist

Ask a supervisor or co-worker to observe your lifting technique to identify what you are doing right and what you can improve upon using the checklist below.

IMPORTANT: These lifting techniques are only for lightweight loads that can easily fit between your knees. Ideally, you should lift from a position higher than the floor.

Boxed Items

Yes	No	Observation
☐	☐	Pre-lift stretching complete
☐	☐	Bent the knees, not the back
☐	☐	Tested the load before lifting
☐	☐	Good grip
☐	☐	Lifted close to the body
☐	☐	Pushed up with legs
☐	☐	Stood, keeping the bag close to the body
☐	☐	Looked straight ahead while moving
☐	☐	Turned with feet, not waist

Bagged Items

Yes	No	
☐	☐	Pre-lift stretching complete
☐	☐	Crouched over the bag with one leg braced and another kneeling
☐	☐	Tested the load before lifting
☐	☐	Good grip
☐	☐	Slid the bag onto kneeling leg and then over to the braced leg
☐	☐	Stood, keeping the bag close to the body
☐	☐	Looked straight ahead while moving
☐	☐	Turned with feet, not waist

Comments

Housekeeping on the Job

Housekeeping includes maintaining order, keeping things in designated spaces and ensuring that areas are neat and clean.

Effects and Benefits

Hazards of poor housekeeping include:

- Trips, slips or bumps into items
- Non-secure items falling
- Pest attraction
- Protruding item injuries
- Fires and chemical exposures
- Hazards concealed by clutter
- Wasted time and unsafe shortcuts
- Underestimation of hazards

Good housekeeping:

- Improves safety
- Reduces fire hazards and pests
- Boosts morale
- Saves time and effort
- Shows high standards and a commitment to quality and safety
- Attracts and pleases customers
- Is part of regulatory requirements

Planning and Inspection

- Document inspections with formal checklists
- Install and secure anti-slip **flooring** in areas that get wet or are difficult to clean
- Replace worn, ripped or damaged flooring
- Avoid placing cords and cables where people could trip over them
- Extension cords are for short-term use (consider installing a new receptacle instead)
- Make sure **aisles, stairs** and **platforms** are well-lit, clean, uncluttered and repaired
- Make sure aisles are wide enough to safely accommodate people/vehicles/materials
- Install warning signs and mirrors at blind corners
- Keep **walls** and other **painted surfaces** clean to reflect light
    - Make sure **safety paint** (such as yellow for hazards and obstructions) is clean and clearly visible.
- Prevent **spilled liquids**, which can cause slips, material damage and health hazards
    - Use appropriate containers
    - Keep lids closed when they aren't in use
    - Use secondary containers, as needed
    - Consult the Safety Data Sheet (SDS)
- Clean and maintain **machines** and **equipment** regularly
- Use drip pans, guards and oil pans where drips, leaks and spills are likely
- Be aware that materials such as dust, oil and fibers on electronics and motors can lead to overheating and fires
- Replace burned-out light bulbs immediately for security and safety
- Replace or fix items such as broken windows, damaged doors, defective plumbing and damaged flooring as quickly as possible

Designated Areas

Select **storage areas** that are convenient without compromising work or safety. Never allow stored materials to obstruct emergency equipment, first aid stations, aisles, stairs or exits. Make sure the area around sprinkler heads and electrical panels is clear. Take only the materials you need for the task at hand to your work area.

Keep **eating, drinking and smoking areas** away from flammable or toxic materials. Clean eating and drinking areas at every shift. Food and beverage waste can produce unpleasant smells and can also attract pests. Never smoke in any non-smoking areas; look for signage to indicate where you may or may not smoke. Designated smoking areas help protect air quality, prevent fires, and prevent chemical inhalation or ingestion. After they cool, empty ash receptacles regularly to prevent fires.

Maintain clean, sanitary **washrooms and other sanitary facilities** to protect health and safety.

Organization and Storage

- Set up suitable fixtures with marked locations for tools
- Put tools away immediately after using them
- Stack pallets horizontally so they won't fall
- Limit pallet stacking height (fire hazard)
- Keep vehicle interiors free of clutter
- Clearly mark all storage areas
- Keep storage areas clean and organized
- Keep storage doors and drawers closed
- Store frequently used items between knee and shoulder height

Cleaning

When a spill occurs, clean it up right away following the safety guidelines of your employer and the Safety Data Sheet (SDS) of the material. Safely dispose of used cleaning materials and use signs to alert people to wet floors, as needed.

NOTE: Never clean up any hazardous substance without the appropriate training and equipment. You may receive specialized training about hazardous waste disposal.

Don't allow combustible waste materials to build up; remove them. Discard oily rags in covered metal containers. Keep hot areas particularly clean and never store combustible materials there. Make sure nothing ever blocks the ability of a fire door to close completely.

Dust, Dirt and Chips

- Enclosures and exhaust ventilation systems can collect dirt, dust and chips
- Use gloves and other protective equipment to protect against splinters/cuts
- Use a standard vacuum cleaner, broom or mop to remove light dust or dirt
    - If you mop, use warning signs to alert your co-workers to the wet floor
    - Dampen floors before sweeping to reduce airborne dust
- Industrial vacuum cleaners are appropriate for heavier jobs or areas such as walls, ceilings, ledges and machinery
- Special-purpose vacuum cleaners and training are needed to clean up combustible dusts and other hazardous substances
- **Do not use compressed air on dust, dirt or chips**
    - It is ineffective and may result in clouds of combustible dust
    - Airborne particles may get into your eyes, strike you or you may breathe them in

Personal Protective Equipment (PPE): Foot and Leg Protection

Wearing appropriate footwear and leg protection reduces injuries in the workplace by protecting workers' feet, ankles, legs and knees. It also reduces lost work hours, improves productivity and protects clothing.

Hazards
Examples of workplace hazards that require you to wear foot and leg protection:

- When heavy objects roll or fall onto your feet, you may break or crush bones
- If you work around sharp objects, you are at risk of cuts and puncture wounds
- When exposed to liquids such as acids, caustics and molten metal, you can get chemical and heat burns
- Working in extreme heat or cold environments may cause blisters or frostbite, respectively
- Working on or around hot, wet or slippery surfaces may cause you to fall
- Working when electrical hazards are present puts you at risk of electrical shock, burns or death
- Improperly fitted footwear can cause blisters and abrasions

Types of Foot and Leg Protection
Leggings protect the lower legs and feet from heat hazards like molten metal or welding sparks as well as from impact or abrasions. Safety snaps allow leggings to be removed quickly.

Metatarsal guards protect the top of the foot from compression injuries. They may be strapped to the outside of shoes to protect the instep area from impact and compression hazards.

Toe guards fit over the toes of regular shoes and protect only the toes from impact and compression hazards.

Combination foot and shin guards provide total coverage for the lower legs and feet. They may be used in combination with toe guards when greater protection is needed.

Chaps protect the upper and lower legs and are usually hazard- or task-specific:

- Chainsaw chaps are made of multiple layers of cut-resistant fabric designed to jam the chainsaw chain and stop the cutting action before it reaches the skin
- Welding chaps are typically made of leather and provide heat and burn protection from sparks and slag

Waders provide waterproof protection for the feet, legs and lower torso.

Safety Shoes

Safety shoes have impact-resistant toes and heat-resistant soles that protect against hot work surfaces common in roofing, paving and hot work industries. The metal shank of some safety shoes protect against puncture wounds.

Electrically conductive and electrostatically dissipative (ESD) shoes protect against the buildup of static electricity in explosive or hazardous locations. Don't use foot powder or wear nylon, wool or silk socks with these shoes. Never wear them if you are exposed to electrical hazards!

Electrical hazard, safety-toe shoes are non-conductive and prevent your feet from completing an electrical circuit to the ground.

Foundry shoes insulate your feet from the extreme heat of molten metal and also stop hot metal from lodging in shoe eyelets, tongues or clinging to metal parts of the shoe.

Thermal-insulated shoes are constructed to resist high heat and cold situations.

Waterproof shoes are constructed to keep the feet dry and comfortable in wet conditions.

Chemical-resistant shoes are constructed of various materials to protect against chemical and biological hazards. Slip-on overshoes or booties can also be used for chemical or biological protection.

Puncture-resistant shoes are designed to protect the midsole of the foot from sharp objects that can pierce or penetrate the sole of the shoe.

Slip-resistant shoes provide slip-resistant tread for wet, oily or greasy floors. Shoe chain, cleats or spikes are also available to fit over existing boots to prevent falls on ice, snow or other slick surfaces. ***Never wear ice or snow cleats when walking on hard surfaces other than snow or ice.***

Selecting the Proper Protection

Select the proper foot and leg protection based on the hazards you may face in the workplace. Footwear should be marked if it is approved for electrical work.

Follow local footwear standards and regulations. In the U.S., safety footwear must meet American Society for Testing and Materials (ASTM) minimum compression and impact performance standards. Check the product's labeling or consult the manufacturer's instructions to make sure the footwear will protect you from the hazards you face.

See Appendix A below for more information on selecting foot and leg protection.

Use and Considerations

Whatever type of foot and leg protection you are required to wear in your job, you must know how to put it on and take it off properly. You should receive hands-on training on:

- How to put the foot and leg protection on properly
- How to adjust straps, laces and other parts for a comfortable and effective fit

- The limitations of the foot and leg protection
- Indications of when to replace old or damaged protective gear

Proper Fit

All footwear and leg protection should provide comfort without compromising protection. The inner side of footwear should be straight from the heel to the end of the big toe. The shoe should grip the heel firmly and the forepart should allow freedom of movement for the toes. The shoe must securely fasten across the instep to prevent the foot from slipping when walking. Improperly fitted shoes can cause abrasions and blisters.

Care and Maintenance

As with all protective equipment, safety footwear and legwear should be inspected before each use.

Shoes and leggings should be checked for wear and tear often. This includes looking for:

- Cracks or holes in the sole or heel
- Separation of materials between the soles and uppers
- Broken buckles or frayed laces
- Metal or other embedded items in the heels or soles that could present electrical or tripping hazards
- Worn down soles and tread that could decrease protection and traction

If you notice any of these conditions, remove the PPE from service immediately and notify your supervisor so you can get a replacement.

Clean, maintain and store foot and leg protection according to the manufacturer's instructions. In general, store it in a clean, dry location away from direct sunlight.

When working in or around dangerous chemicals, decontaminate your footwear so that you don't transfer these chemicals to your car or home and cause exposure to others. Disposable shoe covers may be used in certain environments, such as cleanrooms, to provide a barrier against possible exposure to harmful contaminants and to prevent the transfer of contamination. Properly dispose of them after a single use.

Appendix A: Guide to Selecting Foot and Leg Protection

This chart provides general guidance for the proper selection of foot and leg protection.

Protection	Source(s)	Workplace Environments
Steel-toed safety shoes, boots, and toe caps	Impact, compression, cuts, abrasions	Construction, demolition, renovation, plumbing, building maintenance, trenching, utility work, grass cutting, materials handling
Metatarsal footwear	Severe impact or compression to the top of the foot	Jackhammering, pavement breaking, heavy pipes, steel or iron work, skid trucks
Heat-resistant boots, leggings, and chaps	Molten metal, super-heated fluids	Foundry work, welding operations
Chemical-resistant footwear and legwear	Splash hazard or direct contact; work with certain chemicals	Acid and chemical handling, degreasing, plating, and spill response
Static dissipative (SD)	Use with static dissipative flooring	Work on electronics, computer components, solvent-based paints, explosives, and plastics
Conductive footwear (CD)	Work near or in explosive or hazardous atmospheres; DO NOT use when exposed to electrical hazards	Explosives manufacturing, grain milling, spray painting, or similar work with highly flammable materials
Electrical hazard (EH) footwear	Work on or near exposed energized electrical wiring or components; DO NOT use in areas that have potential flammable or explosive atmospheres	Building maintenance, utility work; construction; wiring; work on or near communications, computer, or similar equipment; and arc or resistance welding
Leggings	Impact, compression, cuts, abrasions	Logging operations, tree work, chainsaw work
Waders	Wet environments	Wet environments such as lakes, pools, pits, and fishing
Chaps	Impact, compression, cuts, abrasions	Tree service, logging operations, chainsaw work

Walking/Working Surfaces

Slips and falls on walking and working surfaces are a major source of workplace accidents. Elevated platforms, runways, ladder rungs, stairs, steps, scaffolds and outdoor areas are commonly overlooked walking and working surfaces. Wear shoes with soles suitable to working conditions.

Housekeeping
Housekeeping is an important factor in all work environments and plays a vital role in maintaining a safe workplace. Keeping walking and working surfaces tidy can prevent people from slipping, tripping or falling due to clutter or slick surfaces.

Walkways and Floors
Keep aisles clear and in good repair. Aisles should be sufficiently wide where mechanical handling equipment is used. Use covers or guardrails to protect personnel from the hazards of:

- Open pits
- Tanks
- Vats
- Ditches

Floor Loading Protection
Do not place a load on the floor or roof of a building or other structure if the load is heavier than the load rating limit. Check with your supervisor if you are concerned about heavy loads that you need to place in or carry through an area.

Ladders and Steps
Portable Ladders
Maintain ladders in good condition. Inspect ladders frequently and before each use, and withdraw them from service if they have defects.

- Tag or mark defective ladders as "Dangerous, Do Not Use"

Place ladders on level, solid ground unless you secure or stabilize them to prevent accidental displacement. Secure any ladder that must be placed on a slippery surface. If you use a ladder to access a roof or other area, make sure it extends at least 3 feet (0.9 meter) above the point of support.

When climbing or descending a ladder:

- Face the ladder
- Keep both hands on the ladder
- Do not carry objects that can interfere with your ability to grasp the ladder
- Remember that the top of a regular stepladder is not safe for standing

Fixed Ladders
It's common to find cages and wells on tall ladders, but these protections are often ineffective at stopping falls. Newer ladders have systems that stop or prevent falls. A ladder safety device is any device, other than a cage or well, designed to eliminate or reduce accidental falls and

may incorporate such features as friction brakes and sliding attachments. Landing platforms provide a means of interrupting a free fall and serve as a resting place during long climbs.

Step Bolts and Manhole Steps

- Step bolts and manhole steps must be uniformly spaced and in good condition
- Do not exceed the maximum intended load
- Inspect each step visually before use; report any issues, such as a bent or missing step, or if you slip or lose your grip

Stairs and Steps

Standard stairs provide access from one walking-working surface to another when operations necessitate regular and routine travel between levels, including access to operating platforms for equipment. When using stairs and steps:

- Keep a clear view of your footing
- Make sure you have good lighting so you can easily see the next step
- Keep a hand free to grab the stair railing if you lose your footing
- Don't carry anything that keeps you from seeing the next steps
- Know that wet or slippery shoes are as dangerous as a wet or slippery surface

Scaffolds

- Follow the specific safety guidelines for the type of scaffold you use
- The footing or anchorage for scaffolds or planks must be sound, rigid and capable of carrying the maximum intended load without settling or displacement
- Maintain scaffolds in a safe condition; do not use damaged or weakened scaffolds
- Do not alter or move scaffolds while they are in use or occupied
- Install guardrails, midrails and toeboards on all open sides and ends of platforms more than 10 feet (3 meters) above the ground or floor; install wire mesh between the toeboard and the guardrail along the entire opening where persons are required to work or pass under the scaffolds

Dock boards and Ramps

- Secure loading ramps and dock boards (bridge plates) to prevent slipping
- Newer dock boards have raised edges on the sides to prevent accidental runoff
- Use handholds on portable dock boards to permit safe handling when the dock board must be repositioned or relocated

Falls and Falling Objects

Open-sided work platforms and surfaces present a risk of falls to lower levels or falls onto or into dangerous equipment. Prevent or stop falls with:

- Guardrails
- Work positioning
- Restraint systems
- Safety nets
- Personal fall arrest systems

Slips, Trips and Falls for Construction

Most slips, trips, and falls can be prevented by simply practicing good safety habits.

Definitions

Term	Definition
Slip	A loss of balance caused by too little friction between a person's foot/feet and his/her walking surface
Trip	A loss of balance caused by the interruption of the movement of a person's foot by an obstacle
Same-level fall	A slip and fall, trip and fall, or step and fall. Occur more often than elevated, but are associated with fewer and less serious injuries.
Elevated fall	A fall from any distance, such as from a ladder, down stairs, off equipment, or from docks, trees, roofs or other height. Occur less often than same-level, but are associated with more serious injuries.

Fall Hazards

Causes of Slips and Trips

The following are just some examples of items in the workplace that can cause **slips**:

- Water
- Mud
- Grease/Oil
- Leaves and pine needles
- Food
- Dust
- Plastic wrapping
- Highly polished floors
- Loose floorboards or tiles
- Metal surfaces
- Mounting/dismounting vehicles/equipment
- Transitioning from one surface to another

Examples of **trip** hazards include:

- Clutter
- Tools
- Cords, cables, hoses in walkways
- Obstacles in aisles and walkways
- Changes in elevation or levels
- Irregularities in walking surfaces
- Missing or uneven floor tiles or bricks
- Non-uniform or irregular steps

Housekeeping and Equipment

Housekeeping and improper equipment use can cause slips and trips:

- Poor housekeeping
  - Items on the ground or on steps
  - Spilled liquids or water
- Inadequate/bad lighting
  - Too dark
  - Glare
- Improper or careless use of equipment
  - Ladders, scaffolds, vehicles, etc.
  - Wearing the wrong shoes

Bad Habits

Bad habits can cause slips and trips:

- Carrying objects that obstruct view
- Not using handrails
- Moving too fast to avoid hazards
- Taking shortcuts
- Being distracted

Protect Yourself
What can you do to avoid the causes of slips, trips and falls?

- Keep work areas neat
    - Eliminate clutter from aisles
    - Keep floors clean and dry
    - Maintain drainage, using gratings or raised platforms
    - Use caution signs on wet floors
    - Use boot brush stations
    - Eliminate protruding nails, splinters or loose boards
    - Take care when using cords
    - Block off or mark hazardous areas
- Keep work areas well-lit
    - Avoid lighting that's too dark or too bright
    - Keep work areas, stairs and aisles well-lit
    - Avoid wearing sunglasses indoors
- Use equipment correctly
    - Know the:
        - Weight of the equipment and materials you will be using
        - Location of skylights and floor hole covers
        - Load capacities of structures
    - When working at heights, watch out for electrical lines, moving equipment and unguarded mechanical parts
- Develop good habits

Ladders
To avoid slips and trips related to ladders:

- Use the right ladder for the job
- Do not use makeshift ladders such as barrels, boxes or sawhorses
- Follow these guidelines when climbing or descending:
    - Only one person should be on a ladder at a time
    - Always face toward the ladder when climbing up or down
    - Keep your belt buckle area between the side rails to avoid over-leaning
    - Use both hands when climbing or descending
    - Never carry anything in your hands
    - Use three points of contact (two hands, two feet equals four points)
- If a ladder is required as part of your job, you must have ladder safety training
- Ladders should be placed with a secure footing and should be lashed or held in position
- Ladders used to gain access to a roof or other area should extend at least 3 feet (0.9 meters) above the point of support
- Place the base of extension or straight ladders 1/4 of the working length of the ladder away from the base of the structure
- Ladders should never be used in the horizontal position as scaffolds or work platforms
- Never use metal ladders near electrical equipment

Stepladders should be equipped with a metal spreader or locking device of sufficient size and strength to securely hold the front and back sections in the open position

- All ladders should be maintained in good condition
- They should be inspected frequently and before each use

- If you find a defect:
    - Tag it out of use
    - Secure or lock it up so others can't use it
    - Report it to maintenance or your supervisor

Scaffolding

There are different types of scaffolds, each with their own regulations and requirements. Some of the general requirements that apply to all scaffolds are:

- The footing or anchorage for scaffolds must be sound, rigid and capable of carrying the maximum intended load without settling or displacement
    - Unstable objects, such as barrels, boxes, loose brick or concrete blocks, must not be used to support scaffolds or planks
- Scaffolds and their components must be capable of supporting at least 4 times the maximum intended load
- Scaffolds must be maintained in a safe condition and must not be altered or moved horizontally while they are in use or occupied
- Damaged or weakened scaffolds must be immediately repaired and cannot be used until repairs have been completed
- A safe means must be provided to gain access to the working platform level through a ladder, stairs or a ramp
- Overhead protection must be provided for personnel on a scaffold exposed to overhead hazards
    - Guardrails, midrails and toeboards must be installed on all open sides and ends of platforms more than 10 feet (3 meters) above the ground or floor
    - Wire mesh must be installed between the toeboard and the guardrail along the entire opening, where persons are required to work or pass under the scaffolds
- Employees must not work on scaffolds during storms or high winds or when scaffolds are covered with ice or snow

Stairs

Because you use stairs so regularly, you may take them for granted, but in fact, a large number of slips, trips and falls occur on stairs.

- Look where you are going
- Make sure you can see around what you're carrying
- Take one step at a time – never skip steps
- Hold handrails
- Keep steps clean and dry

If You Fall

- Try to keep your wrists, elbows and knees bent
- Do not try to break the fall with your hands or elbows
- It is better to land on your arm than on your head
- It is better to land on your buttocks than on your back

Mobile Elevated Work Platforms (MEWPs)

Types of Equipment
Aerial lifts raise personnel to an elevated work position on a platform supported by masts or booms. They include extensible or articulating boom platforms, aerial ladders and vertical towers (mast lifts).

Scissor lifts can lift larger loads and provide more workspace than aerial lifts. They are not for lifting extremely heavy materials. They generally provide the most space for multiple workers. They mostly lift straight up/down but may also shift horizontally.

Vertical mast lifts can lift personnel in tight quarters. They lift straight up/down, have multi-stage masts, and have platform extensions that extend beyond the base of the vehicle.

Preparation
Prepare the People
Everyone who uses mobile elevated work platforms needs training about their equipment and site BEFORE they work. Only **trained** and **authorized** persons should operate mobile elevated work platforms.

Prepare the Equipment
Select the appropriate lift for the task/capacity/surface. **WARNING: Operating an indoor, solid-tire, slab lift on outdoor, rough terrain is a common contributor to serious tip-over incidents.**

Follow manufacturer's instructions to perform the **pre-use inspection** of the equipment, including the vehicle and lift components.

If you discover an unsafe condition, tag the lift "Out of Service" and report the issue to the appropriate person immediately.

Prepare the Site
Survey the work area (risk assessment) for:
- Overhead hazards
- Electrical lines
- Moving equipment/people
- Material and debris
- Ground/floor conditions
- Slopes/grades
- Lighting

Take precautions such as:
- Placing barricades
- Posting signs
- Insulating tools/equipment
- De-energizing powered equipment/utilities

- Performing lockout/tagout

Safe Operation

- Extended outriggers or stabilizers can help prevent tip-overs
- Follow manufacturer's directions about operating or not during windy conditions
- Use fall protection and appropriate tie-off points on mobile elevated work platforms
    - You CAN be injured even if the fall arrest system functions flawlessly
- Move with the lift lowered when traveling, and survey the area before lifting again
- Look in the direction in which you are traveling
- Travel with the counterweight upgrade
- Follow manufacturer's guidance about turning on grades
- Do NOT travel with people in the platform or bucket unless the equipment is specifically designed for this type of operation

Working Safely

- Clean slippery substances off shoes and ladder rungs
- Maintain three points of contact when climbing on access ladders
- Close and secure the chain or gate after boarding
- Put a barricade under overhead activity
- Communicate plans to use mobile elevated work platforms
- Use horns and other signaling devices to make your presence known
- Place tools, equipment and materials on the platform before climbing, or hoist tools, equipment and materials up after boarding
- Avoid clutter on working surfaces, clean up as you go, and only take what you need
- Avoid stepping up on anything when on the platform or in the bucket
- Reorient the lift, rather than leaning out
- Avoid exiting the platform or bucket until it is lowered
    - If you MUST exit at heights, follow manufacturer instructions and company policies, which likely include personal fall protection
- You can fall if you exit the lift onto a place without a proper floor and railings
- Employers must have rescue plans that describe what to do if someone falls
- Remove the keys from the mobile elevated work platform to prevent unauthorized use

Scaffold Safety Essentials

A scaffold is a temporary elevated structure that we use as a platform for workers and equipment. Scaffolds are safe and help workers be more efficient when we set them up and maintain them correctly. Your employer will provide you with training about the scaffolds and hazards where you work. This job aid will focus on supported scaffolds and general scaffold safety.

Types of Scaffolds
There are three general types of scaffolds:

- Supported scaffolds
  - Rest on the ground
  - Have platforms supported by rigid legs, poles, frames or outriggers
  - Are usually made of metal poles or systems or of wood
  - Are commonly used for construction projects
- Suspended scaffolds
  - Have platforms suspended from above by ropes or a non-rigid support
  - Are commonly used for window-washing, maintenance activities and high-rise construction
- Mobile elevated work platforms (such as aerial lifts)
  - Include vehicle-mounted or self-propelled elevated work platforms
  - Are made of metal, wood, fiberglass reinforced plastic or other material
  - May be powered or manually operated
  - Are commonly used for short durations or temporary tasks

General Scaffold Hazards
The purpose of scaffolds it to safely allow people to work at heights but working at heights has its risks:

- Falls
- Falling objects
- Instability
- Collisions
- Electricity
- Poor plank condition
- Weather

Competent Person
The competent person has knowledge and experience and is CAPABLE and AUTHORIZED to predict and deal with scaffold hazards. Competent people are trained and capable of training others about erecting, disassembling, moving, operating, repairing, maintaining and inspecting the scaffold.

Scaffold Requirements
Your employer will enlist competent people and professional engineers to design, construct and maintain scaffolds. EVERYONE must know basic scaffold requirements so that they can identify when something is or could become unsafe.

Stability helps us avoid tip-overs and collapses. Scaffolds should be on stable and level ground with locked wheels and braces. The competent person may require scaffold-grade planks, base plates and mud sills to create a stable surface, as needed.

Use appropriate scaffold **construction** methods with matching components. The scaffold must be able to safely withstand regular use and conditions such as high winds and rain. Scaffolds may collapse because of missing or improper connecting pins. The height-to-base ratio must meet safety requirements. Scaffolds must have safe and proper access methods.

We don't want scaffolds or conductive material on them to be closer to **electricity** than is safe. The competent person will determine safe distances at which to place/use/remove scaffolds. When safe distances are not possible, the competent person must arrange for the electrical utility company to de-energize, ground and/or shield the lines.

Rails must be around access points and open sides and ends to help prevent falls. The competent person knows and will follow safety regulations regarding where and how to install rails.

Scaffolds may have **toe boards, screens or chutes** along with **barricades** and **limited access** to protect people blow from dropped material.

Planking and **decking** should be in good repair and should not have visible bowing. Planking and decking should be free of cracks, dry rot and slick materials (snow, ice, mud, etc.). Planks must be secured, not just laid down. Platforms must be fully planked from front to rear. There should not be any gaps between boards. Planks must have adequate overlap, as determined by the competent person. Overlaps should be on bearers.

The braces, couplers, connections, mud sills, base plates, leveling screws and tie-ins must be strong enough to support the scaffold, the people, the materials and the work. Many scaffold **systems** are prefabricated/engineered so that their components work together. If you notice that parts seem mismatched, please alert the competent person. Even slight leaning can cause hardware failure and collapse, so please report it immediately.

Safe Work Strategies

Safe work on and around scaffolds includes:

- Limited and appropriate access. Only authorized people should be on or around scaffolds. Access scaffolds using designated ladders, stairs, ramps and walkways, NOT unapproved parts of frames and cross-braces. Take care when climbing on or off scaffolds
- Protection from falling objects. Protect people below from tools, materials, equipment, or other objects that may fall from a scaffold. Practice good housekeeping and keep objects away from edges. Wear a hard hat on construction sites, especially when you are on or around scaffolds
- Moving mobile scaffolds safely. Do not move scaffolds when people are on them. Before you move a scaffold, look for obstructions overhead and check for debris or holes on ground
- Personal fall arrest systems (PFASs). If you use a personal fall arrest system (PFAS), your employer will train you to inspect, use and store it safely. Use the anchor or tie-off points designated by the competent person. NEVER tie off to a standard scaffold guardrail
- Training and inspections. The competent person will provide training and will perform safety inspections and tag scaffolds to indicate if they are safe for use

Unsafe Conditions

When you work on or around scaffolds: 1) recognize potential problems; 2) address them, block them, and/or stop work; and 3) report them.

Ladder Safety for Construction: Selection and Inspection

All workers need to know how to select and inspect ladders to prevent injury or death.

Portable Ladders

- Can be moved
- Types include:
    - Step
    - Straight (fixed length)
    - Extension (variable length)
    - Job-made (only when properly built)

Choosing the Right Ladder

- Choose the right ladder for the job
    - Scaffolds or scissor lifts may be better suited for strenuous or pushing and pulling work
    - Ladders should be used for brief work and occasional access to higher work surfaces
- Use fiberglass ladders around electricity
- Check safety label for information about:
    - Type
    - Grade
    - Duty rating (weight capacity)
    - Model or ID number
    - Highest standing level
- Note that aluminum and lightweight fiberglass ladders are typically rated for 200-300 pounds (90-136 kilograms). This includes the weight of the person, any tools or materials being carried, and the force of movement as you climb and descend

Inspecting a Ladder

- Inspect the ladder – every time you use it – for:
    - Modifications (paint, reinforcements, alterations)
    - Missing company/manufacturer identification on side or guard rail
    - Damage to ladder hardware (locks, brackets, hinges) including rust or bending
    - Defective rungs, steps, surfaces or side rails
    - Damaged or missing feet or supports
    - Missing non-slip pads (without these, ladders can move and slide out from underneath workers)
- On extension ladders, check for missing or damaged:
    - Extension ladder mechanisms
    - Rung dogs or locks
    - Pulley system
    - Ropes and rail guides
    - Braces, end caps or closures
- On stepladders, check for:
    - Damaged pail shelves (items may fall on people below)
    - Damaged spreaders or spreader assemblies

- On platform ladders, check for:
    - Missing, warped, frozen, uneven casters, wheels, stops or locks on platform ladders
    - Corroded, bent or not-level standing surfaces
- If a ladder is defective, remove it from service. Tag it, secure it and report defects to your supervisor/foreman
    - You may be asked to put a lock and chain around an unsafe ladder to physically prevent use prior to replacement or repair

Ladder Safety for Construction: Setup and Use

Moving a Ladder
When you move a ladder, retract or collapse all parts, fully close the ladder, and lock everything in place. Carry the ladder horizontally. Always check for obstacles at each end before making a turn. You may also need someone to walk ahead of you to open doors in your path.

When carrying a ladder by yourself:

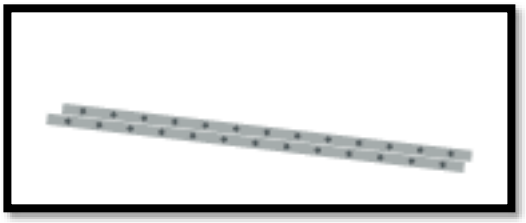
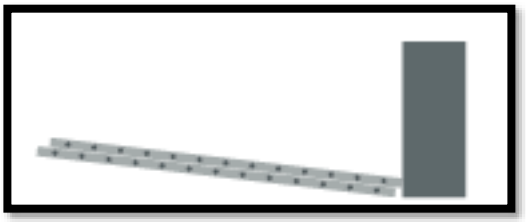
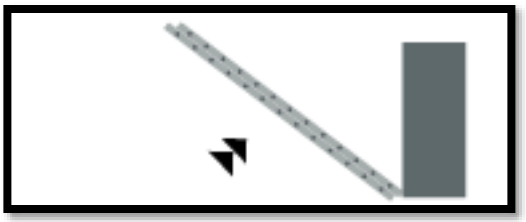
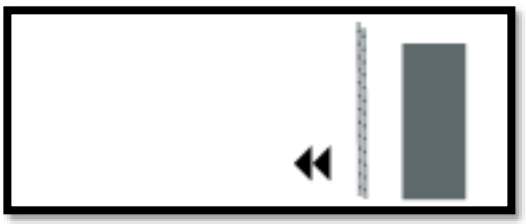
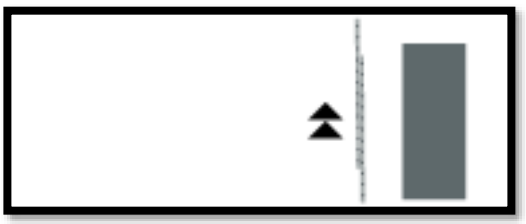
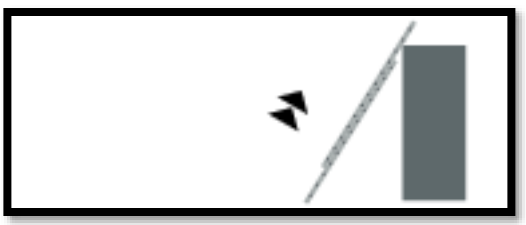
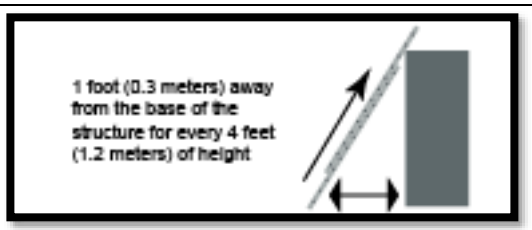
- Put your arm through the ladder
- Rest it on your shoulder
- Grab a forward rung with your other hand
- Keep the center balanced

When possible, ask a co-worker for help carrying a ladder. Both people can carry the ladder with their arms through it and the side rail on their shoulders. Another common two-person technique is carrying the ladder much like a suitcase with each person's arms down at their sides. Very heavy or very long ladders may be carried using three people with the ladder flat on their shoulders.

Setting Up a Ladder

- Before setting up a ladder, **check for overhead electrical wires and moving objects**
- **Clear the area** around the base of the ladder of debris
- If you must use a ladder in high-traffic areas, **set up barricades**. In a doorway, post signs and lock or block the door
- Assess if you will need **fall protection**
- Never set ladders on top of boxes or bins to add height
- Never set ladders on top of a vehicle or machinery that can move
- Set ladders on a non-slippery, even surface
    - Sweep away sand and dirt that could cause the ladder to slip
    - Secure the ladder at the base anytime you must use it on a smooth or potentially slippery surface
- If your ladder has flexible feet:
    - Set the feet horizontally on hard surfaces
    - Turn the feet at right angles to the side rails and "plant" the feet vertically on soft surfaces
- Place the ladder on a **firm, level footing**
    - NEVER put a ladder on boxes, bins, vehicles, machines, or slippery or unstable surfaces
    - You may need to shovel out underneath to ensure an even surface (do NOT level with rocks or planks)

Raising an Extension Ladder
Raising an extension ladder can be a two-person job, but one person can raise a single or multi-section ladder by walking it into position using a hand-over-hand technique.

1. Close the ladder and position it with the base section on top of the fly section.	
2. Block the bottom of the ladder against a fixed object (such as a wall) or another person's foot.	
3. Check for overhead clearance and power lines, and "walk" the ladder up to a vertical position.	
4. Keep the ladder vertical and move it away from the supporting structure several feet or meters.	
5. Raise the fly section using the rope and pulley system, placing one foot on the base rung.	
6. Carefully lean the ladder against the supporting structure.	
7. Place the base of the ladder **1/4 of the working length of the ladder away from the base of the structure**. This equals roughly 1 foot (0.3 meters) away from the base of the structure for every 4 feet (1.2 meters) of height.	

- The distance from the base of the ladder to the structure is correct when you can place one foot against each side rail, extend your arms straight out in front of you, and touch a rung without lowering or raising your arms
- Ensure that the upper section rests on (or is in front of) the bottom section with enough overlap. The bottom section and rung dogs should face the supporting structure
- Rest **both side rails on the top support**
- Ensure the ladder leans against something substantial
- Ensure ladder side rails won't slide across smooth wall surfaces

Verify Safe Setup

- On stepladders, make sure spreaders are fully open and locked
- Make sure the tallest point to be reached from the stepladder is accessible from the second rung from the top
- Regardless of the type of ladder, all ladder sections and parts need to be locked in place before climbing
- Physically secure the ladder whenever repeated or extended use is expected and when any aspect of setup and use presents a risk that requires extra stability
- Lash or otherwise secure the side rails at the landing surface so they don't move when people step onto or off ladders

Securing a Ladder

- To secure the base of a ladder, screw or nail a 2-foot x 4-foot (0.6-meter x 1.2-meter) cleat to the decking behind the ladder's feet to prevent the ladder from slipping backward
- A staked cleat can be used behind the ladder's feet on soft ground
- Another method is to lash or brace the ladder's side rails to a solidly anchored object or directly to the structure on which the side rails are resting
- Lashings should connect low on the ladder, ideally around the lowest rungs
- Stakes can be driven into the ground if there is no suitable structure to tie to

Weather

ALL work at heights is dangerous during lightning, high winds, rain, sleet or snow. Check with your company's safety officer to determine when work should be suspended.

Climbing a Ladder

- Remember: Only one person can be on a ladder at a time (unless it's intended for two)
- **Face the ladder** when going up or down and when working from it
- **Maintain three points of contact** by keeping two hands and one foot, or two feet and one hand, on the ladder at all times
- **Do NOT carry objects** in your hands while climbing

Prevent Falls

- Keep your belt buckle area between the side rails to avoid over-leaning
- Don't climb higher than is safe
    - Avoid going above the fourth rung from the top of a straight or extension ladder
    - Avoid going above the second rung from the top of a stepladder
- **Never stand on the top rung of a ladder!**

Crane Operator Safety

Worksite Preparation

- Determine safe site access
- Investigate support surfaces
    - Use blocking and cribbing
    - Ensure level surfaces
    - Be aware of hidden or invisible hazards like underground tanks
    - Near an excavation with vertical sides, never allow the crane to get closer to the gap than the depth of the excavation (for loose soil, the depth × 1.5)
- Check for utility lines and transmitters
    - De-energize transmitters
    - Choose synthetic taglines to reduce the risk of shock
    - Allow a minimum clearance of 60 cm (2 ft) around all objects
- Arrange the work area
    - Use signs/barricades/signalers
    - Control public access
    - Wear high-visibility clothing
- Set up the crane appropriately
    - Maintain equipment
    - Check for corrosion/damage/wear-and-tear
    - Ensure that adequate space is available for the crane to be assembled and operated safely

Equipment Around Power Lines

When working near overhead lines:

- Survey the work area for hazards
- Locate equipment/activities a safe distance from power lines
- Notify the owner before work begins
- Consider a line energized unless the power company confirms it is not AND it is visibly grounded
- Ensure flagged warnings are in place to mark horizontal and vertical clearance distances
- Use tag lines only when the load might spin into lines, and use polypropylene instead of wire rope
- Observe clearance minimums
- Use non-conductive tools

Be sure the utility company has confirmed the voltage and safe working distance from the power lines. Also, if crane work activities come within 6 meters (20 feet) of lines, you will need:

- An observer
- Barricades
- Pre-task plans including emergencies
- An insulated link
- A boom cage guard
- A proximity device

Learn about specific precautions to follow where you work.

Emergency Procedures for Power Line Contact

- Stay in the crane except in cases of fire or arcing
- If necessary, jump clear of the crane
- Do not touch the crane and the ground at the same time
- Take small steps; shuffling away with your feet together and on the ground will minimize the potential for electric shock
- Avoid touching the crane or load
- Be aware that power may go off and on
- Break contact if safely possible

Minimum Clearance Distances

Voltage (nominal, kV, alternating current)	Minimum clearance distance
Up to 50 kV	3 meters (10 feet)
Over 50 to 200 kV	4.5 meters (15 feet)
Over 200 to 350 kV	6 meters (20 feet)
Over 350 to 500 kV	7.6 meters (25 feet)
Over 500 to 750 kV	10.6 meters (35 feet)
Over 750 to 1,000 kV	13.7 meters (45 feet)
Over 1,000 kV	Must be established by the power line owner/operator or registered professional engineer who is a qualified person with respect to electrical power transmission and distribution

Operation

Avoid **tipping** by never exceeding limits specified on the load chart and range diagram and using outriggers. Maintain visibility of the boom and load block and use a signal person, as needed.

Signaling

- Make sure hand signaler is visible
- Repeat and confirm voice commands before operation is performed
- Stop operations if:
    - A "Stop" command is given
    - More instructions are needed
    - Instructions are misunderstood or unclear
    - Operator is unable to see/hear the signaler

Special Operations

Review safe operations and practices for special operations, such as:

- Pick and carry
- Clamshell and dragline
- Pile driving and drilling shafts
- Demolition work
- Barge work and turning a load
- High-voltage scrap magnets

Conditions Affecting Operations

There are certain conditions that can affect the normal course of operations. The most common of these are the environment, side loading, dynamic loading, and equipment condition.

Cold and freezing temperatures:

- Reduce crane strength
- Increase load weight
- Freeze parts to ground

Wind:

- Increases load instability at higher levels
- Causes power lines to swing

Water and wet conditions:

- Affect mechanical parts
- Alter load weight
- Obscure and weaken support surfaces

Extreme temperatures:

- Cause power lines to sag

Poor visibility:

- Slows down operations
- Masks obstructions
- Obscures hand signals; use voice signals instead

Side loading:

- Must be limited to the amount caused by a freely suspended load
- Capacity must be reduced for loads not listed in the load chart
- Never deliberately pull or drag a load sideways

Dynamic loading:

- The faster you move, the more dynamic forces you create
- The greater the weight of the load, the greater the dynamic load
- The faster the speed of operation, the greater the dynamic load

Crane Terms

Ball	Used in conjunction with the boom hoist drum to change the crane's boom angle
Block	The block contains the pulleys and the hook that attaches the load to the crane
Blocking	The placement of wooden blocks, other designated blocking materials, or jack stands under equipment and components to keep them secure and stable
Boom	The "arm" that extends to give the crane the ability to lift a load over an area
Boom point	Where the jib connects to the boom
Cab	The operator's compartment on a crane
Clutch	A device for the engagement or disengagement of power

Cribbing	The placement of a machine or component onto alternating tiers of blocks that act as a support base to create stability
Dragline bucket	Dragline attachments are used to excavate or hoist material that is below the grade on which the crane is placed, such as underwater
Drum (winding drum)	The cylindrical object that the hoist wires wrap around to raise and lower the load
Dynamic loading	Extra force applied to the crane that is not accounted for in the load chart. The forces produced by wind, swinging the load, and abrupt stopping are examples of dynamic loading.
Extension	A boom extension or "fly." Generally weaker than the main boom.
Float	A rigid support that attaches to an outrigger to spread the surface load weight
Fly jib	An extension attached to the boom for added length to carry the load. Also referred to as jib or boom extension.
Guy line	A tensioned wire cable used to support and stabilize the crane by counterbalancing
Hoist	The action of lifting and lowering the load
Holding line	The line that holds the load block
House	The house covers the machinery mounted on the upper revolving frame
Jib	An extension attached to the boom for added length to carry the load. Also referred to as fly jib or boom extension.
Jib backstay	Works with the strut to raise and support the jib
Jib strut	Works with the backstay to raise and support the jib
Load block	The block contains the pulleys and the hook that attaches the load to the crane
Lower	The portion of the crane located below the turntable bearing at the top of the crane tower
Lower sheave	A wheel with a groove for a wire rope to run on. The lower sheave is located above the hook
Outriggers	The parts of the crane that extend outward to stabilize it by increasing the footprint over which the load is carried
Pick and carry	The lifting of a load and traveling with it suspended
Power pin	Secures the connection of two booms or of a boom and jig
Reeving	The passing of ropes over pulleys or sheaves
Side loading	Using the crane to pull or push a load horizontally when the load is not free to swing with the crane
Slewing platform	The part of the crane that contains the cab and that allows the crane to rotate
Swing brake	Controls and stops excessive swing of the load lines
Tag line	The tensioned line that keeps the load in line with the crane and helps reduce swinging. Also, a rope used by personnel on the ground to help guide a load into place.
Upper	The portion of the crane located above the turntable bearing at the top of the tower
Upper sheave	A wheel with a groove for a wire rope to run on. The upper sheave is located at the upper rip of the boom or jig.

Crane Signaling Awareness

The person directing lifting operations (**Lift Director**) is ultimately responsible for the crane's work. The **crane operator** manipulates the equipment controls. The **signal person** directs crane movements using hand or voice signals. Only one person should give signals, except emergency stop, which anyone may give.

Crane signalers help crane operators avoid obstructions. The operations that crane signalers direct can affect crane capacity and the swing of the load. Operating crane safely truly is a team effort!

Effects of Crane Movement
Capacity: The boom and radius must be as short as possible to lift the maximum weight. Changing the crane position and extending the boom length and/or radius will decrease the capacity of the crane.

Dynamic Loading: Heavy or fast-moving loads take more time to stop than light or slow-moving loads. Signalers must give advance notice so that operators may stop loads gradually and safely.

Boom Deflection: Boom deflection means that as you apply lifting forces on a load, the boom bends down slightly. The rigging must be pulled tight and the boom must deflect completely before the load leaves the ground. When lowering the load, the signal person must ensure the boom is NOT deflected before it's safe to detach the load.

Stuck Loads: Lifting loads that are stuck can strain the crane or cause sudden movement that can lead to damage or tip-overs. Signalers must let crane operators know when they are trying to lift a stuck a load so that the operator knows what to expect.

Multiple Functions: Some cranes are unable to perform boom and hoist functions at the same time smoothly or safely. The signaler and operator must understand equipment limitations and plan accordingly.

Two Blocking: Two blocking occurs when the headache ball or hook block contacts the boom tip. It is especially common on telescopic boom cranes when telescoping the boom.

Side Loading: Side load occurs when the center of gravity of a load is not directly under the crane hoist. Too much side load can cause the boom to collapse.

Methods
Crane signalers communicate with crane operators using clear and constant standardized hand signals and voice commands. Prior to beginning operations, the team will meet to:

- Review the work plan and hazards
- State the crane capability/limitations
- Identify each other
- Agree on signals/commands

Hand Signals

Hand signals require:

- Positioning (same side of boom as operator)
- Visibility (distance, weather, light, etc.)
- Exact delivery

Voice Signals

Voice signals require:

- Tested systems (clear, reliable, dedicated channel, hands-free for operator)
    - Free of interference
    - Will not detonate remote explosives
- Clear, slow, deliberate words
- Directions given from the operator's perspective (operator's left/right)

Voice signals begin with an identifier when there is more than one crane. The signaler must then deliver voice commands in this standard order:

1. Function and direction.
2. Distance and/or speed.
3. Function stop.

Example: "North crane, swing right 10 meters. 5 meters…4…3…2…1. Load stop."

IMPORTANT: Anytime the operator cannot see, hear or understand the signaler, work should immediately stop.

Resources

Before work begins, a designated person will test signalers to make sure they have a basic understanding of crane operation and limitations and know standard hand/voice signals. **Hand signal charts** should be posted on the equipment or in the vicinity of hoisting operations.

Communication Barriers

Weather/Vision. Rain, fog and dust can impede the crane operator's ability to see a hand signaler. Wind can muffle radio operators' voices. The glare of the sun at certain positions may make it difficult for crane operators and signalers to see each other. Check forecasts and consider how weather and visual impediments may impact communications. Discuss these issues prior to beginning the work.

Language/Speech. If a voice signaler has a strong accent or speech impediment, it's important to ensure that the crane operator can clearly understand him or her. Consider using hand signals instead, if language or speech could cause confusion.

Interference. Other radio devices and lightning can cause radio interference. Hand signalers in busy areas may be distracted. It's important to test equipment and make everyone on the site aware of where signalers are located so that they can avoid distracting them or using devices that may interfere with their equipment.

Decisiveness/Confidence. If something doesn't seem right, people need to speak up and alert others to potential issues. Signalers must be able to make decisions with confidence and stop work, if needed. Signalers without these qualities can put people and property at risk.

Stop Work
EVERYONE has the responsibility and authority to stop work if they feel that unsafe conditions are present or if they do not understand directions.

The signal for an emergency stop is to extend both arms horizontally with palms down. Then, swing the arms back and forth.

The voice and hand signals for stops and emergency stops should be part of the pre-work briefing.

ANY interruption in communication between the crane operator and the signaler should result in an immediate stop.

The operator should stop crane movement to communicate or obtain clarification from the signal person, as needed.

Basic Rigging Principles, Part 1: Hazards and Risks

Rigging is the process of using specialized equipment to lift and move heavy loads. Rigging may also refer to the specialized equipment we use to attach and move heavy loads.

Rigging Purpose
People who perform rigging carefully choose equipment based on the weight and balance of the object they need to move to a designated place. Rigging activities may involve lifting extremely heavy objects at great heights or through narrow or confined spaces. The goal is always to safely move objects from one place to another.

Industries in which people perform rigging include:

- Construction (building, remodeling, demolition, infrastructure)
- Manufacturing and industrial (assembling equipment, vehicles or ships)
- Road construction (moving the heavy materials required to build bridges)
- Commercial (harvesting oil, gas and trees; mining; maintaining telecommunication networks)
- Transportation (loading/unloading, moving train cars, boats and ships)
- Entertainment (moving sets, lights, speakers and cameras)

Hazards
Generally, rigging may expose workers to fall hazards, struck-by or crushing hazards and electrical hazards. Being aware of these hazards is the first step to making safe choices. Only qualified people are allowed to perform rigging activities, and they have the training and experience required to account for these hazards.

Fall hazards may be created by:

- Uneven surfaces
- Slick surfaces
- Obstructions
- Unprotected sides, openings or holes

Electrical hazards can be created by:

- Rigging near energized lines
- Failure to ground tools/equipment
- Defective electrical tools and cables

Struck-by and crushing hazards include:

- Equipment tip-overs onto people or objects
- Equipment failure that causes loads/equipment to swing or drop
- Falling loads that strike people below
- Moving parts/loads/equipment that strike people or objects
- Loads pinning people and crushing them against objects

Think about how environmental conditions (winds, slick surfaces), imbalanced, unstable and oddly shaped loads can increase the risks associated with these hazards.

Rigging operations may need to be rescheduled or suspended when there is high wind, lightning or rain.

Basic Rigging Principles, Part 2: General Safety

The process of rigging includes preparing for the job, doing the job safely, and inspecting and storing equipment.

1. Preparing for the job	2. Doing the job safely	3. Inspecting and storing equipment
• Job hazard analysis • Crew organization • Preparation/planning • Pre-job briefing	• Wear PPE • Communicate • Inspect/attach equipment • Use safe practices	• Inspect equipment • Remove defective equipment • Store equipment

Preparing for the Job
A **job hazard analysis** is a document that identifies potential hazards and how to control them. A competent person completes the job hazard analysis with input from supervisors, employees and other professionals.

The **lift director** is in charge of ensuring that people perform the job safely. They are not part of the rigging crew and are not crane operators. Lift directors must:

- Be qualified and competent (or competent with qualified assistants)
- Review and understand all procedures
- Verify that crew members understand their tasks, responsibilities and associated hazards

Lift directors and competent riggers will work together to determine the weight of the load, find the balance point of the load (or center of gravity), check clearances for moving the load and select the rigging equipment to be used.

The lift director will conduct a **pre-job briefing** before every job that will cover:

- Tasks and sequence
- Expected results
- Responsibilities
- Methods of communication
- Environmental concerns
- Previous experience/lessons learned
- Job hazards, precautions and controls
- Documentation to review and use
- Crew input, questions and concerns

Doing the Job Safely
Inspect and wear the personal protective equipment (PPE) that the lift director told you about during the pre-job briefing. This may include:

- Hard hats
- Safety glasses
- Hearing protection
- Gloves

- Safety shoes
- High-visibility vests
- Fall protection, as needed
- Shock- and arc-rated equipment, as needed

Throughout the job, the crew should **communicate** as the lift director described during the pre-job briefing. Communication may include a combination of verbal communication, hand signals and radio communications. Everyone on the crew can and should use stop-work authority to stop work and address questions and hazards, as needed.

The way you attach rigging equipment to a load or lifting device will vary depending on the job. Generally, rigging a load involves:

1. Assembling the load
2. Attaching slings to the assembly
3. Attaching the slings to the lifting device, such as a crane
4. Lifting/moving the assembly
5. Detaching the slings from the lifting device
6. Detaching the slings from the assembly

Safe rigging practices include the following:

- Do not drag equipment or use it to drag a load
- Only use appropriate attachments as they are intended (manufacturer documentation)
- Never let unauthorized personnel in the area
- Never place any part of your body under a suspended load or lift a load over people
- Never place personnel between a moving load and a stationary object or structure
- Never ride on loads or crane hooks
- Do not leave suspended loads unattended
- Keep loads low to the ground so they don't have far to fall if something goes wrong
- Move loads slowly to correct problems before people get hurt or property gets damaged
- Use taglines to control the load as approved/directed by the lift director
- NEVER wrap taglines around body parts, such as hands or arms
- Avoid pinch points that may be created when tension is applied to hooks or slings
- Protect skin and slings from contact with sharp or abrasive edges or surfaces
- Do not trap slings or body parts when landing the load

Inspecting and Storing Equipment

Damaged equipment can cause loads to fall, potentially killing or injuring people and damaging equipment and property.

Competent people should inspect rigging equipment at the beginning of each day or shift. They should inspect equipment and document its condition periodically, at intervals of a year or less. Competent people will receive in-depth training about the condition equipment must be in. They will look for defects that may be more complex or invisible to the naked eye.

Riggers should inspect rigging equipment before using it, after using it and after anyone drops it. Riggers should focus on obvious defects and check with a competent person for guidance, as needed. Riggers will receive training about the equipment they will use and must be able to

spot obvious defects such as:

- Wear
- Cracks or damage
- Kinking
- Corrosion and rust
- Torn or damaged webbing
- Missing or faded labels
- Other damage or deformity

When equipment **fails** an inspection, follow the procedures your employer has regarding how to take defective equipment out of service.

Safely **store** equipment so that it won't be damaged while it is not in use. The floor can expose equipment to wear, water, dirt, chemicals or oils. If possible, hang equipment or lay it in trays. Do not store equipment in extreme cold or hot temperatures or in direct sunlight. Keep storage areas clean and tidy. Check manufacturer documentation for more information about safe storage.

Basic Rigging Principles, Part 3: Rigging Equipment

Rigging equipment failure can cause loads to fall, injuring people and damaging property. By knowing the qualities and characteristics of slings, connectors and adjusters, you can help ensure that equipment and rigging jobs are safe.

Types of Equipment
The general categories of rigging equipment are:

- **Slings** that we loop or form around the load to form hitches
- **Connectors** that link pieces of rigging equipment
- **Adjusters** are devices we use to lengthen or shorten the legs of the rig to place the load hook directly above the load's center of gravity
- **Weight distributors** distribute the weight of the load to more than one point

Slings
Slings may be made of wire rope, chain, metal mesh, or synthetic fiber rope or webbing. Natural fiber rope is generally an UNSAFE material for load-bearing slings but may be used for taglines. **All slings must have a capacity tag permanently attached to them.**

Wire Rope Slings
Wire rope slings are made up of steel strands wrapped or braided around a wire rope core. The helix or spiral of the wires and strands in a rope is called the lay. Wire rope slings are common in the construction, oil and gas and manufacturing industries due to their ability to lift heavy loads and withstand tough conditions.

Advantages	Disadvantages
Lighter in weight than chains	Hard to inspect internal strands
High strength and flexibility	Not repairable
Braids are resistant to kinking	Susceptible to corrosion
Variety of designs for different benefits	

When using wire rope slings never join wire rope slings with different lays or shorten wire rope slings; doing so can seriously affect the slings' lifting capacities. Be aware that the rotation of a load on a single hitch can undo the wire rope strands and weaken the rope.

Remove wire rope slings from service if you find damage, wear and defects. This includes:

- 10 randomly distributed broken wires in 1 rope lay
- 5 broken wires in 1 strand in 1 rope lay
- Kinking, crushing or distortion
- Expanded strands
- Heat and corrosion damage

Chain Slings
Chain slings must be constructed of alloy steel. Chain slings are typically in areas with harsh conditions, such as foundries, steel mills and heavy machine shops. Remove the chain sling from service if you find any links that have cracks or do not hinge freely with adjacent links.

Advantages	Disadvantages
– More resistant to harsh conditions than wire ropes or synthetics – May be repaired, tested and certified if damaged – Damage can be more obvious than other sling types – Turn corners without significant wear/damage	– Heavier than wire rope and synthetics – Less able to stretch than wire rope or synthetics – Can damage or crush sensitive, delicate or finished loads

Metal Mesh Slings

Metal mesh slings are made from carbon steel, stainless steel or alloy steel. They may be coated or impregnated with material that has elastic qualities. Metal mesh slings are useful for loads that are hot, have an irregular shape or have sharp edges, such as in metalworking.

Advantages	Disadvantages
– Flexible – Resistant to heat (untreated metal) – Resistant to corrosion	– Even one broken wire makes them unsafe – Not repairable – Susceptible to crushing damage

When you inspect metal mesh slings, make sure they move or articulate freely and that any handles are free of defects or damage.

Synthetic Fiber or Webbing Slings

Synthetic fiber or webbing slings are made of nylon or polyester. They may have 1 or 2 layers of material. Almost all industries use synthetic slings because they are effective for lifting oddly shaped loads and cylindrical materials.

Advantages	Disadvantages
– Lighter than other types of slings – Material soft and flexible – Can protect delicate loads from scratching and crushing – Variety of designs for different benefits	– Not as durable as other types of slings – Easily cut/damaged by abrasive and sharp edges – May be damaged/melted by prolonged exposure to direct sunlight – Require more frequent inspection in harsh conditions – Not repairable

Remove synthetic slings from service if you find broken stitches, snags, discoloration, punctures, cuts or damage. Do not use attachments with sharp edges or projections on synthetic slings.

Hitches

Rigged slings are called hitches. We categorize hitches based on the type of sling we use and how we rig it to the load. **Endless sling hitches** are continuous loops with no connectors.

Single-leg sling hitches are slings with eyes or loops at each end. The eyes often contain an insert called a thimble to help retain the shape of the eye.

Hitch Type	Endless	Single-Leg
Vertical	✓	✓
Basket	✓	✓
Double basket hitches	✓	✓
Double-wrap basket	✓	✓
Choker hitch	✓	✓
Doubled choker		✓
Double-wrap choker		✓
Multiple-leg (bridle)		✓

You can use both endless and single-leg slings to create a **vertical hitch**. In both cases, we lift the load using a single sling from the center of gravity on the top of the load.

When you are using a wire rope sling, use more than one to prevent or limit twisting motions that unwind the cables and weaken the rope. Do not use vertical hitches to lift loose materials or long or unbalanced loads.

You may create **basket hitches** with endless or single-leg slings by passing the sling under the load and up its sides to create a cradle for it. Use **double basket hitches** (basket hitches in pairs) for added stability, especially with wide loads. **Double-wrap basket hitches** loop completely around the load before going up its sides. This allows them to grip the load and keep the sling from slipping.

To form a **choker hitch**, pass one end of the sling around the load and then couple it to the upright portion of the load. For endless slings, couple it by using the looped end, and for single-leg slings, couple it by using a free-running shackle or sliding hook. A **doubled choker hitch** provides more contact area and may help riggers turn loads. Place both sling eyes on top of the load, pointing in the direction that is opposite to the direction of the turn. A **double-wrap choker hitch** wraps the sling once around the load before it couples to the upright portion of the sling for added grip and to prevent slipping.

Multiple-leg hitches, also called bridle hitches, include slings that have two or more legs. Each leg usually attaches to an eye on the load with a shackle. Typically, the legs are gathered at a ring that attaches to the load hook of the lifting device. Competent riggers usually determine what type of bridle hitch they need in advance and assemble it before the job. Riggers use adjusters (turnbuckles) to position the load hook directly above a load's center of gravity.

Connectors

Connectors are hooks, eye bolts and shackles that riggers use to link pieces of rigging equipment.

You may connect **hooks** to shackles, eye bolts or directly to the eye of a sling. Make sure hooks have safety latches, wherever possible, to keep loads on hooks. Check hooks for spreading and bending, cracking (often inside the shank) and safety latch operation.

Shackles are U-shaped connectors with pins that riggers use to couple slings to hooks, slings to eyes, and hooks to eyes. Riggers may also use shackles to make a choker hitch with a single-leg sling. A screw-pin shackle has a body and a pin. The body collects the ends of slings. Place the pin on the crane hook or through the eye of an eye bolt. **Never substitute a bolt for a shackle pin.** Substituting a bolt for a shackle pin is dangerous because ordinary bolts are much weaker than a hardened steel shackle pin. Inspect the body of the shackle for bending, cracking and damaged threads. Check the pin to make sure it is straight, and its threads are free of stretching or stripping.

Eye bolts are threaded connectors on loads where riggers attach slings. Straight-shank eye bolts are for straight lifts only. If an angled load is applied to a straight-shank eye bolt, the shank will bend or break. Shouldered eye bolts are designed to be stronger when weight is applied at angles ≥ 45°.

Adjusters

Turnbuckle adjusters are threaded bodies with screws at each end. Turning the screws will lengthen or shorten the turnbuckle. Turnbuckles are ideal for small adjustments. Inspect turnbuckles for bending, spreading and cracking and make sure the screw threads are in good condition.

Selection

Generally, a competent rigger will choose rigging equipment that can handle a capacity of at least 1.5 to 2 times the weight of the load. The competent rigger will also consider the material with which the equipment is made to evaluate its advantages and disadvantages given the job and its environment.

Hitch configuration influences the tension on rigging equipment:

- More sling legs reduces the amount of tension on any one leg
- Tension may be concentrated at sharp bends and cinch points.
- The more a sling's angle departs from being vertical, the more tension

Hazard Communication for Construction: Written Program

The purpose of the **Hazard Communication (HazCom) Standard** is to ensure that employers and employees know about work hazards and how to protect themselves to reduce the incidence of illnesses and injuries due to hazardous chemicals.

The Standard covers chemical manufacturers, importers, distributors, employers and employees exposed to chemical hazards. It applies to general industry, shipyards, marine terminals, longshoring, construction and healthcare.

The purpose of the **Globally Harmonized System of Classification and Labelling of Chemicals (GHS)** is to reduce confusion and, therefore, worker injury and illness. It standardizes an international approach to the HazCom Standard. It also sets specific criteria for hazard warning labels and a 16-section format for Safety Data Sheets (SDSs).

Types of Hazards

- **Physical hazards** can cause serious accidents and injuries (ex: flammable/explosive)
- **Health hazards** can affect a person's short-term or long-term health (ex: toxic)

Responsibilities

Chemical **manufacturers** must:

- Evaluate the hazards of the chemicals they manufacture
- Label products according to the HazCom Standard and provide a safety data sheet (SDS) with each chemical they ship

Importers and distributors of chemicals must ensure proper labeling and transmit an SDS with each chemical they ship.

Companies must:

- Identify and list hazardous chemicals in the workplace
- Obtain safety data sheets and labels for each hazardous chemical, if not provided by the manufacturer, importer or distributor
- Implement a written HazCom program, including:
    - Hazard classification
    - The written program
    - SDSs and labels
    - Training

Hazardous Chemical Inventory

Companies must:

- Identify and list all hazardous chemicals to which workers could potentially be exposed
- Consider chemicals in all forms (liquids, solids, gases, vapors, fumes and mists)
- Identify chemicals in containers (including pipes) and consider chemicals generated in work operations, such as welding fumes, dusts and exhaust fumes

Written Program
The written program must include all of the following:

- The hazardous chemicals present at the jobsite
- Who is responsible for the various aspects of the program
- Where written materials will be made available
- How information will be exchanged at multi-employer jobsites
    - How site owner, general contractor, and subcontractors coming onsite will communicate
- How the jobsite meets the requirements for:
    - Container labels and other forms of warning
    - Providing access to SDSs
    - Providing information and training
- How employees will be informed of non-routine task hazards
- The ways in which pipes and piping systems are marked

Training
Companies must train workers about the hazard communication program:

- Before potential exposure or work with a hazardous chemical
- Whenever the hazard changes
- Whenever a new hazard is introduced into their work area

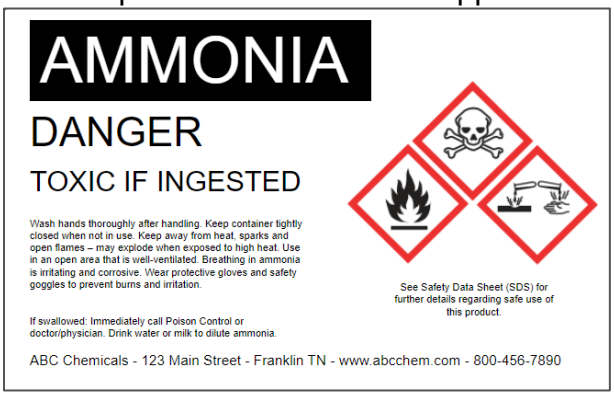
Expect to learn about:

- Where hazardous chemicals are present
- Where to find the written program, hazardous chemical inventory and SDSs
- The physical and health hazards of chemicals
- How you can protect yourself from chemical hazards
- How to detect the presence or release of a hazardous chemical

Hazard Communication for Construction: How to Use Labels and Safety Data Sheets

Hazard Warning Labels

- Labels must be legible, in English (plus other languages, if desired), and prominently displayed
- Labels include:
  - Product name or identifier
  - Pictograms (symbols) (example: oxidizing chemicals have a circle with flames)
  - Signal words ("Danger" is more severe than "Warning")
  - Hazard statements describing physical, health and environmental hazards
  - Supplemental information
  - First aid statements
  - Precautionary measures (labels contain four types of precautionary statements: "prevention," "response," "storage" and "disposal")
  - Name, address and telephone number of the supplier



Safety Data Sheets (SDSs)

SDSs have a specific 16-section format:

- Identification of the substance or mixture and of the supplier
- Hazards identification
- Composition/information on ingredients
- First aid measures
- Firefighting measures
- Accidental release measures
- Handling and storage
- Exposure controls/personal protection
- Physical and chemical properties
- Stability and reactivity
- Toxicological information
- Ecological information
- Disposal considerations
- Transport information
- Regulatory information
- Other information, including date of preparation or last revision

SDSs:

- Are to be prepared by the chemical manufacturer, importer or distributor and must describe:
    - Physical hazards, such as fire and explosion
    - Health hazards, such as signs and symptoms of exposure
    - Routes of exposure
    - Precautions for safe handling and use
    - Emergency and first aid procedures
    - Control measures
- Must be in English (other languages are optional) and include information regarding the specific chemical identity and common names
- Must provide information about the:
    - Physical and chemical characteristics
    - Health effects and first aid
    - Carcinogenicity (cancer-causing ability)
    - Identification (name, address and telephone number) of the organization responsible for preparing the sheet
- Must be readily accessible to employees in their work area

Manufacturers must evaluate the hazards of chemicals. If no SDS has been received for a hazardous chemical, your employer must contact the supplier, manufacturer or importer to obtain one and maintain a record of the contact BEFORE you use the hazardous chemical.

Industrial Hygiene Awareness

What Is Industrial Hygiene?
Industrial hygiene is:

- The art and science of preventing/controlling conditions that may expose people to workplace contaminants and physical agents that can harm their health
- A job title or part of a job description
- A focus area or principle in all occupational health and safety programs

We can use the science of industrial hygiene in all industries to protect workers, their families and the community.

What Does Industrial Hygiene Target?
Contaminants and physical agents that can harm people's health may include:

- Air contaminants (pollution, particles, vapors)
- Chemical hazards (products, pesticides, metals)
- Biological hazards (blood, mold, sewage)
- Physical hazards (noise, temperature, radiation)

Workers may be exposed to contaminants or hazards by:

- Inhalation (breathing things in)
- Ingestion (eating/drinking/smoking contamination)
- Injection (sharp objects and open wounds)
- Absorption (skin/eye/mouth contact)

The health effects of an exposure may be:

- Acute (immediate)
- Chronic (long-term)

The duration and intensity of the exposure may be a factor in health effects.

Occupational exposure limits (OELs) are how much of contaminants or physical agents an average worker may be exposed to at work over a set period before they may suffer harmful health effects. There may be limits for full or partial shift exposures.

The limit at which harmful health effects may occur may be lower for people with:

- Chronic diseases (autoimmune, cancer, asthma)
- Pregnancy
- Advanced age
- Excess weight
- General health problems

People who have any of these risk factors may need to work within limits that are lower than the OEL. In recognition of individual susceptibility differences, some companies adopt limits which are more stringent than those required by law.

Many contaminants and physical agents can be difficult to see/measure. We may need to use special measuring devices to determine their presence and concentration.

How Does Industrial Hygiene Work?
There are five general methods, in descending order of effectiveness, that we can use to apply industrial hygiene and reduce exposures to contaminants and physical agents that can harm health.

- **Eliminate** it by redesigning the process (example: outsource tasks to specialists)
- **Substitute** it with a safer process or product (example: use robots instead of people or choose safer chemicals)
- Provide **engineering controls** at the source (example: use exhaust vents/hoods)
- Reduce exposure through **administration** (example: mandate breaks and assign people in shifts)
- Use **personal protective equipment (PPE)** for added protection (examples: wear gloves when handling bodily fluids and put on hearing protection before entering noisy areas)

The best way to keep people safe and healthy is to use a **combination of controls**. The protection provided by controls can be additive, and if one control fails, other controls may be able to reduce exposure severity or prevent harmful health effects.

Asbestos Hazards: Workers in the United States

Asbestos is a heat-resistant mineral that may be in fire-resistant and insulating materials. When workers inhale it, it can cause lung damage and diseases, like cancer. Managing exposure to asbestos is so important that the government regulates how to keep workers safe.

Regulations
The U.S. Environmental Protection Agency (EPA) and the Occupational Safety and Health Administration (OSHA) are responsible for regulating environmental exposure and protecting workers from asbestos exposure. OSHA is responsible for the health and safety of workers. The EPA develops and enforces regulations to protect the public and the environment. Your employer must also comply with state and local regulations.

The most important consequence of failing to comply with regulations regarding asbestos is that people will become sick and may even die. Additionally, employers who fail to comply face significant fines, permit suspensions, liability, lawsuits and jail time. Your employer wants people to be safe. They need YOUR help to identify and avoid dangerous conditions.

Classifications and Training Requirements
OSHA classifies asbestos work in four levels. As you move from Class IV to Class I, each level has increasingly stringent training and control requirements:

- **Class IV** workers perform custodial activities in which they may contact ACM
- **Class III** workers focus on repair and maintenance operations where workers may disturb ACM or PACM
- **Class II** workers remove other types of ACM that are not TSI. This includes resilient flooring and roofing materials that contain asbestos and asbestos-containing wallboard
- **Class I** workers remove thermal system insulation (TSI) and sprayed-on or troweled-on surfacing asbestos-containing materials (ACM) or presumed asbestos-containing materials (PACM). This class of asbestos workers has the most stringent training and control requirements

OSHA requires employers to train all workers who may contact or be exposed to ACM about who is responsible for managing ACM, the location of ACM in their work areas, operations and maintenance (O&M) programs and responding to emergencies involving ACM.

Medical Surveillance and Recordkeeping Requirements
Employers must provide free medical exams to workers who engage in any asbestos work other than maintenance or custodial work for 30 or more days per year where asbestos is present but will not be disturbed. Medical surveillance program exams include a comprehensive medical questionnaire, a physical examination and a full lung-function exam.

Medical professionals will provide employers with written results and opinions regarding the patient's health risk if exposed to asbestos. They will only share information related to asbestos exposure. Employers must provide copies of the results to the patient within 30 days of receiving them. Exams will happen every year.

Employers must keep accurate physical or digital records of:

- Monitoring measurements for 30 years
- Medical surveillance for the duration of the employee's employment plus 30 years
- Training records for 1 year beyond the last date of employment

Asbestos Hazards: Characteristics and Health Effects

Asbestos is a group of compounds made up of fibers that form rocks underground.

Physical Characteristics
Asbestos **fibers** can be:

- Serpentine (curly, layered sheet structure)
- Amphibole (straight needle, chain-like structure)

The fibers are strong, flexible, resistant to heat, fire, chemicals, water, electricity, wear and friction and sound-absorbent.

People use asbestos fibers in **manufactured products** such as:

- Building materials (roofing, tiles, wall and pipe insulation)
- Friction materials (vehicle clutches, brake pads)
- Heat-resistant fabrics (clothing, carpeting, fire blankets)

Friable Asbestos
Asbestos that is not intact can be extremely dangerous to human health. There is no safe level of exposure. When it deteriorates over time and in harsh conditions to the point that you can easily crumble it by hand or turn it into a powder by sawing, scraping or sanding it, we call it **friable asbestos**.

Friable asbestos breaks into microscopic fibers that stay suspended in the air for hours or days. People may inhale the fibers or carry them away from the worksite where others may inhale them. Once asbestos fibers are in the lungs, they tend to stay there for many years.

Health Effects
Inhaling or ingesting asbestos fibers causes chronic (long-term) health effects including asbestosis, mesothelioma and lung cancer. People may develop these conditions 10 to 40 years after they've been exposed. The risk of developing these diseases generally increases with the intensity and duration of exposure and with individual risk factors, such as smoking and pre-existing lung disease.

Amphibole (straight) fibers are generally more dangerous than serpentine (curly) fibers because they are easier to inhale.

Using asbestos is restricted or banned in most countries.

Asbestosis
Asbestosis is a serious, long-term, slowly progressing lung disease. It is caused by asbestos fibers that aggravate and scar the lung tissue. The scars may make it difficult to breathe and difficult for oxygen and carbon dioxide to pass through the lungs. Smoking causes more scarring, which can accelerate the onset of asbestosis.

Regarding **symptoms**, some people are asymptomatic, and others have shortness of breath and a dry crackling sound upon inhaling. In its advanced stages, asbestosis may be disabling and can cause heart failure.
There is no **treatment** for asbestosis. Doctors focus on slowing the progression of the disease, treating its symptoms and preventing complications. Doctors may prescribe supplemental oxygen and a pulmonary rehabilitation program.

Lung Cancer

Lung cancer is a malignant tumor that invades and obstructs the lung's air passages. It causes the largest number of deaths related to asbestos exposure.

The **risk** of getting lung cancer after asbestos exposure depends on the type, severity and duration of the exposure and personal factors like age and tobacco use. Smoking greatly increases the risk of developing asbestos-related lung cancer and dying from it.

Lung cancer may not cause **symptoms** in the early stages. Eventually, it may cause chronic coughing, shortness of breath, persistent chest pains, hoarseness, weight loss or fever. Consult a physician to rule out or confirm lung cancer is present.

Treatment may include surgery, radiation therapy, chemotherapy or a combination of these activities.

Mesothelioma

Mesothelioma is a rare, aggressive form of cancer in the thin membranes that line the chest and abdomen. It is caused when people inhale or ingest asbestos fibers. Most people who are exposed to asbestos do not develop mesothelioma, but it is still a possibility of which you must be aware. Doctors report a history of asbestos exposure through work or living with an asbestos worker in about 80% of mesothelioma patients.

Mesothelioma has the same **symptoms** as lung cancer and may also include pain in the lower back and belly, nausea, vomiting and constipation.

The **treatment** options for mesothelioma are surgery, radiation therapy, chemotherapy or a combination of these activities.

Asbestos Hazards: Products and Types

Asbestos is strong, flexible and resistant to heat. These characteristics are why it was used in many products, before we realized it could cause respiratory diseases, including lung cancer.

Presumed Asbestos-Containing Materials (PACM)
You can't tell whether a product contains asbestos just by looking at it. We must assume that certain products contain asbestos unless analysis indicates otherwise.

You may encounter older products, such as those that were made before the 1980s, that contain asbestos. If they were installed before 1981, the following products are presumed asbestos-containing materials:

- Sprayed-on or troweled-on surfacing material (SM)
- Thermal system insulation (TSI)
- Resilient flooring

Treat all dust and debris from PACM and ACM as if they contain asbestos. Check your local regulations to determine if there are more PACM that they add to this list and act accordingly.

Asbestos in Manufactured Products
Presumed asbestos-containing materials (PACMs) are not the only products that may contain asbestos. Because asbestos is strong, flexible, resistant to heat and sound-absorbent, it may be in building products, friction products and heat-resistant fabrics and other products.

REMINDER: If you suspect asbestos may be present, assume that it is until testing and analysis prove otherwise.

Any of the following that was made before 1981 may contain asbestos:

- Roofing, shingles and siding
- Fireproofing and insulation in building walls and ceilings
- Ceiling tiles
- Putties, caulks and cements
- Joint compound, spackling compound and tape
- Soundproofing or decorative materials
- Rubber gaskets
- Automobile brake pads and linings, clutch facings and gaskets
- Fireproof gloves, stove-top pads and ironing board covers
- Hairdryers
- Insulation inside appliances
- Artificial ashes and embers for gas-fired fireplaces

Asbestos Types
Chrysotile is the most common asbestos in building materials. It is also called white asbestos and is often found in brake pads, disk pads, gaskets and pipe insulation. It may also be in floors, ceilings, walls and roofs. Its fibers are serpentine (curly).

Amosite is the second most common asbestos in building materials, and it is also called brown asbestos. It is often found in cement sheets, insulation, insulation boards, roofing, tiles and fire protection materials.

Crocidolite is also called blue asbestos and it is the most hazardous type (small, needle-like fibers). It does not resist heat as well as other types.

Tremolite and **actinolite** are not mined/used commercially now. They may be in products such as insulation, paint and plumbing materials.

Anthophyllite is the rarest asbestos mineral and is primarily made of iron and magnesium. It is yellowish-brown, reddish-brown or green and is rarely used in commercial products.

Damage and Deterioration
When asbestos is friable, it breaks into small, airborne fibers that people may inhale or ingest. They can cause respiratory diseases, including cancer. Signs of damage or deterioration on a product that may contain asbestos include breakage, crumbling, cracks, fraying, dust and water damage.

Some activities will make intact asbestos become friable. Examples of work on buildings that were built before 1981 that may disturb asbestos include:

- Removing roof or floor tiles or popcorn ceilings
- Replacing wall or roof insulation
- Sawing, drilling, sanding or scraping joint or spackling compound
- Cutting pipe insulation
- Knocking or blowing on brake components

Asbestos Hazards: Signs, Areas and Monitoring

Knowing when asbestos is present helps you make informed, safe decisions to avoid asbestos exposure.

Is Asbestos Present?
Prior to 1981, people used asbestos fibers in manufactured products such as:

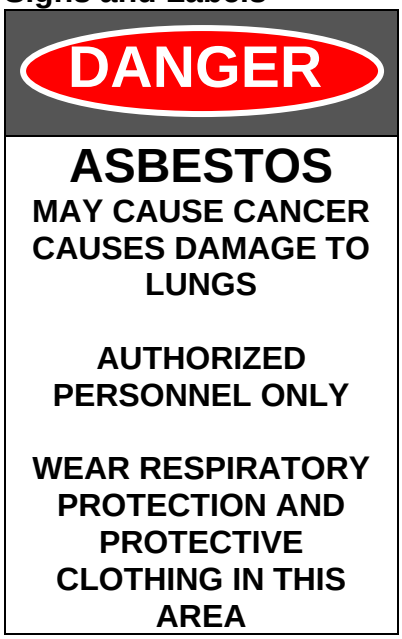
- Building products
- Friction products
- Heat-resistant fabrics and other products

Treat all dust and debris from these products as if they contain asbestos.

Other ways to determine if asbestos is present:

- Professional testing
- Talk to building owners
- Look for signs of damage or deterioration of products that may contain asbestos
- Monitoring
- Read signs/labels

Signs and Labels



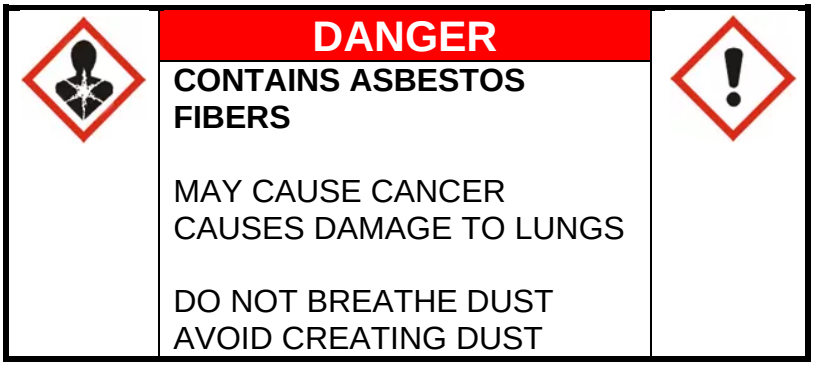
Signs alert you *before* you get to areas that have asbestos in them. Signs remind you why asbestos is dangerous and what protective measures to take in the area.

DANGER is always the signal word for asbestos, and it is always at the top of the sign, with a red background so that it stands out.

Signs state that asbestos is present and warn you of its health hazards: cancer and lung damage.

Only authorized people may enter the area. These people have received training specific to safely managing asbestos exposure.

The sign reminds authorized personnel who enter the area to wear the required respiratory protection and protective clothing.



Labels are attached to anything that contains asbestos fibers, including materials, debris and containers.

Asbestos labels include DANGER, carcinogen and irritant pictograms, and how people may be exposed. Carefully read labels and follow any directions they provide.

Regulated Asbestos Areas
Regulated areas are work areas that may exceed the asbestos thresholds and exposure limits identified by regulators. We must prevent asbestos dust from spreading beyond regulated areas! Controls vary depending on the activities and concentrations of asbestos in the area.

Regulated areas are supervised by a competent person who can identify and control asbestos hazards. No one should eat, drink, smoke, chew tobacco or gum or apply cosmetics in a regulated area.

NOTE: Check the regulations in your country and locality to determine specific requirements for regulated areas and specific exposure limits for asbestos.

Monitoring
Before beginning work, a competent person completes an analysis that tells them about the presence, location and quantity of asbestos in the area. They will use this information to determine the appropriate control systems to make sure no one inside or outside regulated areas is exposed to asbestos beyond the limits identified by regulators, such as 0.1 f/cc over an 8-hour period or 1 f/cc over 30 minutes.

The competent person will monitor asbestos at periodic intervals, at least every 6 months, until their analysis indicates that asbestos levels are below the limits set by regulators. They must do additional monitoring when processes, control equipment or work practices change. Employees may observe the monitoring methods that the competent person uses. Employers will notify affected employees of the monitoring results in writing or by posting a notice.

Regulators in your area may use terms such as occupational or permissible exposure limits, excursion limits, threshold limit values and maximum allowable concentrations to describe the amounts of asbestos that they consider unsafe. If you have questions about the terms and limits in your area, please ask your supervisor.

Medical Surveillance Program
If you perform certain asbestos work more than 30 days per year or are exposed to asbestos beyond the regulator's limits, your employer may be required by law to provide you with a medical exam by a licensed physician at no cost to you. Exams may include a questionnaire, a

physical examination, a chest x-ray and a lung function test. The physician will send your employer their findings or diagnoses related ONLY to asbestos exposure.

The physician may provide a written opinion to your employer about any medical conditions you have that could increase the risk of damage to your health from exposure to asbestos. You should receive a copy of all information the physician provides to your employer within 30 days of the employer receiving it.

Recordkeeping

Your employer will keep medical and monitoring records for the duration of your employment plus 30 years. Employers will keep training records for the duration of your employment plus 1 year. You may examine and copy their records relating to your health and asbestos exposure.

Asbestos Hazards: Avoiding Exposure

Inhaling or ingesting asbestos fibers can cause lung diseases and cancer. To control asbestos exposure, we a combination of:

1. Engineering controls
2. Administrative controls
3. Personal protective equipment (PPE)

Preventing Disturbance

Assume that building, friction and heat-resistant products installed before 1981 contain asbestos. Only qualified professionals should work on these materials. Intact asbestos-containing materials are not a health risk. They become dangerous when we disturb them by touching, drilling, cutting, sanding, breaking or sawing them. Disturbing asbestos-containing materials send asbestos fibers into the air where people may inhale or ingest them. These fibers can cause lung disease and lung cancer.

Demolition and renovation contractors, carpenters, plumbers, electricians, building owners, inspectors, insurance adjusters and real estate agents are just a few examples of people who may encounter and disturb asbestos when they are working.

When possible:

1. Leave intact asbestos-containing materials alone.
2. Have a professional repair the damaged areas by sealing or covering them.
3. Have professionals remove asbestos.

Only qualified professionals should touch, move or perform work on asbestos-containing materials. If you disturb asbestos materials, assume that asbestos fibers are in the air and dangerous. Leave, decontaminate and wait for qualified professionals to make the area safe.

Engineering Controls

Engineering controls isolate people from asbestos fibers. Examples:

- Point-of-cut ventilators or enclosures with high-efficiency particulate air (HEPA) filtered exhausts
- Impermeable drop cloths and mini-enclosures or glove bags
- Ventilation to move fibers toward HEPA filtered collection devices or exhausts
- Misting units that keep the air moist so that fibers are heavier and less likely to become airborne

Administrative Controls

Administrative controls change how qualified professionals work so that they can avoid asbestos fibers. Engineering controls are tools and administrative controls that tell us when and how to use them. Examples:

- Following safety policies and procedures
- Observing warning signs and labels
- Housekeeping
- Following hygiene and decontamination practices

Wet Methods

Wet fibers tend to settle down instead of being suspended in the air like dry fibers. Qualified professionals repeatedly mist or gently spray asbestos-containing material with amended water, which contains surfactant chemicals. **Surfactant chemicals** reduce the surface tension of the water and penetrate the asbestos-containing materials. Your company will determine what surfactant chemicals to add to the water and in what proportion based on applicable regulations and industry best practices.

Qualified professionals may spray amended water from a tank or a tap or hydrant with a special nozzle. Wet method examples:

- Misting dislodged floor tiles before putting them in a disposal bag
- Saturating fireproofing before scooping it up

Qualified professionals may wet the material, let the amended water absorb, rewet the material to begin work, and then wet it again during the work to prevent drying.

Housekeeping

Housekeeping includes keeping surfaces as free of asbestos waste as practical. Qualified professionals must wear appropriate PPE during housekeeping tasks.

Qualified professionals will promptly place all asbestos-containing waste in properly labeled, sealed and leak-tight containers or bags. They will begin cleanup by using HEPA vacuums, which are designed to remove very small particles or fibers, such as asbestos. After they vacuum, qualified professionals will mist the air.

NEVER dry sweep, dust or use compressed air to remove asbestos-containing materials, debris or dust. Instead, wipe areas with wet cloths.

Vacuum carpets twice with a HEPA filtered vacuum and use wet mops on hard flooring. Empty HEPA filtered vacuums or change their filters in a physically isolated area.

Place debris and used cleaning equipment in properly labeled, sealed and leak-tight containers while they are still wet. Place contaminated personal protective equipment and clothing in asbestos waste containers and bags.

People exiting the regulated asbestos area must use a decontamination area that has an equipment room, shower area and clean room. Place contaminated equipment and clothing in labeled, sealed, impermeable bags or containers.

Make sure all waste containers and bags can be sealed effectively and aren't too full.

Follow applicable regulations for waste removal, transport and disposal.

Personal Protective Equipment (PPE)

The goal of PPE is to prevent asbestos fibers from getting on clothing, bodies and hair and to prevent people in regulated asbestos areas from inhaling or ingesting it.

Qualified people in regulated asbestos areas must wear appropriate:

- Full-body clothing/suits
- Head coverings
- Gloves
- Foot coverings
- Vented goggles
- Face shields
- Respirators

A competent person must examine coveralls and bodysuits at least once per work shift to verify that it is free from rips or tears and immediately mend or replace it, as needed.

Do not wear contacts when asbestos exposure is possible. Instead, wear prescription safety glasses or goggles under your face shield.

The level of potential asbestos exposure determines the type of respirator that is required for people in the area. Half-face or full-facepiece, negative pressure, air-purifying respirators have replaceable high-efficiency filters. Half- or full-facepiece powered air-purifying respirators (PAPRs) have replaceable high-efficiency filters and a battery-powered pump. People may be able to replace a negative pressure respirator with a powered air-purifying respirator if it offers equal protection.

People wearing respirators must receive training, fit-testing and medical clearance.

NOTE: In the United States, any respirator that workers wear must be approved by the National Institute for Occupational Safety and Health (NIOSH). Check applicable regulations in your area for similar or additional requirements.

Asbestos Hazards: Release Response

Inhaling or ingesting asbestos fibers can cause lung diseases and cancer. Ideally, we identify asbestos-containing materials and then either leave them intact or work on them with controls in place to prevent exposure. When there is an asbestos fiber release, everyone must know what to do to minimize the impact on the health of people in the area.

Asbestos Fiber Release
Assume that asbestos is in building, friction and heat-resistant materials that were installed before 1981.

Asbestos releases occur because:

- People aren't trained to recognize when asbestos is likely to be present
- People don't understand the danger of asbestos fibers
- People accidentally disturb asbestos-containing materials that they intended to leave intact
- Demolition uncovers previously hidden asbestos-containing materials
- Controls (engineering, administrative or personal protective equipment) fail

A **minor release** is < 3 linear or square feet (0.28 linear or square meters) of asbestos-containing material. A **major release** is ≥ 3 linear or square feet (0.28 linear or square meters) of asbestos-containing material.

When ANY asbestos release occurs, our goal is to minimize the spread of fibers and keep people safe.

NOTE: Check applicable regulations and company policies and follow them. When in doubt, follow the more stringent requirements.

For a **minor release** of < 3 linear or square feet (0.28 linear or square meters) of asbestos-containing material:

1. Stop work.
2. Evacuate the area, closing doors behind you.
3. Place contaminated clothing/equipment in sealed and labeled bags/containers.
4. Clean yourself with soap and water before donning clean clothes.
5. Post signs warning.

Alert your supervisor about the asbestos release. Only qualified professionals should work in the release area to remove the asbestos. Your supervisor will decide if your training qualifies you to clean up the release.

For a **major release** of ≥ 3 linear or square feet (0.28 linear or square meters) of asbestos-containing material, follow the same procedure for a minor release and isolate the area:

- Restrict airflow from the release site (shut down or seal HVAC systems)
- Prevent access by erecting temporary barriers with signs on them

The people who are qualified to respond to a major release may have more extensive training than those who may respond to a minor release. They are often asbestos and hazardous material specialists.

After ANY asbestos release, do not re-enter the area until you are instructed to do so by your supervisor. The area is not safe until your supervisor verifies that the cleanup was successful.

First Aid and Medical Attention

If it's possible that you…	Then, immediately…
got asbestos in your eyes	flush them with water for 15 minutes
got asbestos on your skin	wash with soap and water
inhaled asbestos	move to fresh air
ingested asbestos	rinse your mouth thoroughly and then drink water; do NOT induce vomiting

After you take these initial steps, **get medical attention as soon as possible** so that your doctor can assess and monitor you.

Crystalline Silica Awareness

What Is Crystalline Silica?
Silica is an abundant mineral that makes up the Earth's crust. Crystalline silica is a basic component of soil, sand, granite, quartz and many other minerals.

Where Is Crystalline Silica?
When crystalline silica is crushed into small enough particles, it can become airborne. You can breathe it in or it can get in your eyes or on your skin. Crystalline silica that you can breathe is known as **respirable crystalline silica**.

Cutting, sawing, drilling or crushing concrete, brick, rock, mortar, industrial sand or other stone products can produce respirable crystalline silica. Activities such as cutting a granite countertop, core drilling through a concrete floor, and even sweeping a street can stir up crystalline silica into the air.

What Are the Health Effects of Crystalline Silica Exposure?
Getting crystalline silica in your eyes can cause irritation.

Inhaling respirable crystalline silica can cause:
- Kidney disease
- Chronic obstructive pulmonary disease (COPD)
- Lung cancer
- Silicosis

What Is Silicosis?

Silicosis is a respiratory disease caused by inhaling silica dust. There is no treatment or cure for silicosis and it CAN kill you!

Symptoms include:
- Shortness of breath
- Fever
- Fatigue
- Loss of appetite
- Chest pain
- Dry, nonproductive coughing
- Respiratory failure (may cause death)

If you believe you've been exposed to crystalline silica and notice any of these symptoms, see your doctor.

People with silicosis are also at high risk for developing the active form of tuberculosis (TB).

How Can I Protect Myself from Crystalline Silica Exposure?
Engineering controls:

- Choose a material that doesn't contain crystalline silica
- Install and use ventilation
- Use containment methods
- Use wet sawing/drilling

Administrative and Work Practice controls:

- Exclude non-essential personnel from potential exposure areas
- Schedule cutting tasks when fewer people will be present
- When possible, position yourself so dust blows away from you
- Avoid the use of compressed air when cleaning
- Sweep after wetting the area to suppress dust
- Use a vacuum system with high-efficiency filters Take a shower and wear clean clothes before leaving work

Personal protective equipment (PPE):

- Respirators
- Safety glasses

What Do I Do If I've Been Exposed to Crystalline Silica?
If you get crystalline silica **in your eyes**, flush them immediately with lukewarm water while holding your eyelids open. If irritation persists, seek medical attention.

If you **breathe in large amounts** of respirable crystalline silica, move to fresh air at once. Keep warm and at rest. Get medical attention as soon as possible.

If someone inhales crystalline silica and **stops breathing**, perform CPR and follow your site's emergency procedures.

Corrosive Safety

Corrosive Material
Corrosive materials are **acids** (PH of less than 7) and **bases** (PH greater than 7). A corrosive substance is one that will damage or destroy other substances on contact by means of a chemical reaction, often causing damage within seconds and creating long lasting health implications. This includes skin, metals and cloth.

Effects
Acids and bases damage tissue in different ways. Acids tend to produce immediate pain at the site of contact. Bases may not produce the same immediate warning of damage.

- Delay in pain may lead to longer exposure and more severe injuries
- React with skin oils and triglycerides to form a soap on skin
- Harder to remove from skin

Non-liquid acid and bases include dusts, vapors and gases that can cause both internal and external injuries. Inhalation is the greatest concern and can damage lung tissue and cause pulmonary edema.

Contact with eyes can cause permanent damage such as blindness.

Toxic corrosives can harm organ systems apart from the skin. Significant damage may occur before symptoms appear.

Corrosives can damage containers, equipment, and building components. Reactions can create flammable gas that can burn or explode. Refer to Safety Data Sheets (SDSs) to select the proper container and storage cabinet.

Uses
Industrial uses for corrosive materials include:

- Cleaning industrial components
- Rust and corrosion removal
- Wood pulping
- Glass etching
- Water treatment
- Producing batteries
- Laboratory operations
- Chemical production
- Cleaners for food prep stations

Common household corrosive materials include:

- Bleach
- Ammonia
- Vinegar
- Drain cleaner
- Oven cleaner

- Batteries
- Concrete mix
- Pool chemicals

Recognize Corrosive Materials
Ways to identify the presence of corrosives include:
- Training
- Safety procedures
- Container and pipe labels
- Signs
- Pictograms
- Chemical inventory lists

Labels tell us about chemical dangers and precautions to be followed and should be maintained and accurate. Look on the labels for the product ID (what the product is), signal word ("danger" is more severe than "warning"), pictograms and hazard statements, precautionary information, and PPE codes. Check the SDS for more information.

Proper Use of Corrosive Material
Good housekeeping tips:
- Properly dispose of unlabeled or contaminated chemicals
- Remove empty containers from work areas
- Ensure waste containers are properly marked

After working with corrosives, wash hands after removing protective gloves, especially before eating, drinking or smoking and before using the restroom. When working around hazardous chemical areas do not eat, drink, smoke or chew gum.

Exposure Situations
Exposure situations might include:
- Splashes when pouring from larger containers into smaller ones
    - Corrosion-resistant drum pumps can be used for transferring liquids
    - Hand pumps are also available for dispensing corrosive liquids from most sizes and types of containers
- Do not transfer liquids by pressurizing their shipping containers with air. Ordinary drums and barrels may be damaged by the pressure
- Always wear required protective equipment

Reduce exposure by:
- Handle corrosives so that dusts, mists, vapors, or fumes do not get into the air
- Work in a fume hood to protect yourself and others from breathing corrosive vapors, mists, or dusts, and position the glass sash between you and the chemical as a shield
- Work deliberately, minimize pour height, work upwind so airborne materials will not move in your direction, and, as always, wear required protective equipment
- Dry forms become more hazardous when hydrated. Immediately address potential exposures. Do not blow off with compressed air

- Transport bottles of corrosive liquids in buckets or some other form of protective secondary containment
    - Dropped bottles can shatter and cause splashing of corrosives. Coated shatter-resistant bottles are an option available from some distributors.
- Avoid skin contact with contaminated containers or surfaces
- Clean spills immediately to prevent exposures later
- Pour or transfer liquid over containment trays
- Always handle containers with care
- Replace and discard damaged containers to reduce the possibility of leaks

Reduce Splatters and Mists

- Combining materials could produce high heat
- Boiling or froth can occur
- Possible eruption out of the container
- Always add corrosives to water and use cold water to mix

Storage

Minimize the amount of chemicals on hand and remove any unwanted or expired materials. Practice first-in, first-out management of stored chemicals. Proper storage information can usually be obtained from the SDS, label or other chemical reference material.

Regularly inspect storage containers and areas for corrosion damage, leaking containers, incompatible materials and poor housekeeping. Report and correct all deficiencies as soon as possible. Wear appropriate PPE during inspections.

Storage considerations include:

- Temperature – Cool areas, out of direct sunlight and away from heat sources
- Ventilation – Adequate to prevent buildup of corrosive vapors, etc.
- Segregation and identification – A physical barrier and/or distance is effective for proper segregation

Exposure Emergencies

Before using any corrosive chemical, know where the closest eyewash station and safety showers are located, and how to use them.

Workers who use corrosives and chemicals should know the immediate emergency procedures to take when an exposure takes place.

The first aid for accidental skin or eye injuries usually involves flooding the contaminated area with large amounts of water. However, the specific first aid recommendations can vary from one corrosive material to another. For instance, after flushing, hydrofluoric acid exposures may need to be followed with an antidote such as calcium gluconate gel.

Large Spill Emergency Actions

1. Evacuate the area at once if you are not trained to handle a large spill or if it is clearly beyond your control.
2. Alert nearby workers.

3. Report the situation so specially trained people, equipped with the proper tools and protective equipment, can handle the emergency.

Obtain qualified medical care if you have been exposed to harmful chemicals. Use emergency showers and eyewash stations if needed. The SDS and container label for a particular corrosive should give specific first aid instructions in case of exposure by skin or eye contact, inhalation or swallowing.

Skin Exposures

If a corrosive contacts the skin, flush the area with large amounts of water immediately for at least 15 minutes. Remove contaminated clothes while showering. The shower should have little or no pressure to avoid further damaging injured tissue. Victims may be in great pain and require aid. Seek professional medical care as soon as possible.

Eye Exposures

For eye exposures, use an eyewash station to flush the eyes for a minimum of 15 minutes. The eye lids must be held open for flushing to be effective. Portable eyewash bottles aren't a replacement for plumbed units. Seek medical attention as soon as possible following flushing.

Inhalation Exposure

For inhalation exposures, seek medical attention immediately. The full effects of the exposure may not be evident for several hours. Thus, medical observation/assistance during this time is important.

For all exposure situations, the affected worker should seek medical attention immediately to ensure long-term damage does not take place.

Personal Protective Equipment (PPE): Eye and Face Protection

Your ability to see is precious, so it is important to protect it with the right PPE.

Hazards
Your eyes and face may be injured when they are exposed to:

- Splashes of chemicals or hot liquids
- Flying objects
- Fumes, gases, mists and aerosols
- Electric arc flash
- Biological pathogens in blood and other potentially infectious materials
- Intense light or optical radiation (ultraviolet, visible or infrared light)

Eye and face protection may include specially designed glasses, goggles and face shields. Ordinary sunglasses and vision correction lenses and glasses don't offer standardized hazard protection and are not suitable to protect your eyes and face from the hazards listed above. Eye and face protection should meet applicable regulatory standards specific to your location, such as ANSI Z87.1 in the United States.

Lenses or face shields create a barrier between your eyes and face and hazards that may be present. Lenses are attached to strong frames that prevent them from being pushed into the eyes. Frames are often resistant to heat. Shields may be attached to frames, head bands, helmets or hoods. Shields can be specifically rated for electrical arc flash protection. Lenses and shields may be clear, tinted, photochromic or polarized.

The materials that eye and face protection is made with may resist chemicals, heat and certain types of light, such as arc flash. Check the manufacturer's instructions and read the markings to learn about the features and certifications of each piece of eye or face protection.

Types
Safety glasses are protective eyeglasses with metal or plastic frames and impact-resistant lenses that also can be corrective if needed. **Impact-resistant glasses** are tested per applicable standards that ensure they offer documented protection from flying objects that may impact them.

Goggles protect eyes, eye sockets and the facial area immediately surrounding the eyes. They may be solid or ventilated. Some goggles may fit over corrective vision glasses. **Laser glasses or goggles** provide a range of protection against the ultraviolet, infrared and intense concentrations of reflected light radiation produced by lasers. **Side shields** block particles that may enter the eyes from the side. Most employers require that they be built into safety glasses rather than detachable or clip-on attachments.

Face shields are transparent sheets of plastic that extend from the brow to below the chin and span the entire width of the head. Face shields can protect the face from dusts, splashes and sprays. Wear face shields with safety glasses or goggles. **Arc flash face shields** provide

protection against the heat and intense light of an arc flash. **Welding shields** are made of heat-resistant material and a filtered lens designed to protect the eyes and face from hazards associated with welding, brazing, soldering and cutting. Welding shields are usually integrated with hoods or helmets and may be attached to powered air-purifying respirators. Welding shields protect the eyes from burns caused by infrared, ultraviolet or intense radiant light and from flying sparks, metal spatter and slag chips.

Check the hazard assessment to determine which eye and face protection to use. Ask your supervisor if you have any questions. Check the manual and the markings on the protection for information about its certifications and features.

Use and Considerations

Eye protection should cover the eyebrow to the cheekbone and across from the nose to the bony area on the outside of the face and eyes. Face protection should cover from the brow to below the chin and should span the entire width of the head.

Choose protection that keeps gaps between the edges of the device and the face to a minimum. Your employer may individually assign and fit eye and face protection to meet individual needs.

The frame should be as close to the face as possible. Eye protection is supported by the bridge of the nose and face shields are supported by head bands. Eye and face protection should fit snuggly but should not cause pain or discomfort. Do not modify eye or face protection, such as by adding unapproved padding to nose or earpieces. Make sure you can see in all directions without any major obstructions in your field of view.

Avoid rough handling. Scratches can impair vision, weaken materials and negate protective properties.

If you require corrective vision glasses or contact lenses, consult your employer about how they may impact eye and face protection. Your employer may provide protection that fits over glasses or contact lenses or prescription eye and face protection. If chemical exposure is a hazard, contact lenses may be discouraged or forbidden. Check with your employer for more information.

Care

Inspect eye and face protection before each use. Damage may interfere with vision and may not provide adequate protection. Check for scratches, pitting, chips, cracks, breaks, bending or warping. Also check for twisted, loose, discolored or worn bands or padding. If you find any defects or damage, follow your company's procedures to report the issue, and remove the eye and face protection from service.

Clean and disinfect eye and face protection daily. To help prevent fogging, clean eye and face protection frequently. Use anti-fog cleaning wipes to prevent fogging. Follow the cleaning instructions from the manufacturer to avoid damaging the protection.

Store eye and face protection in a clean, dry place where it will not fall or be damaged. Keep glasses and goggles in a case with the lenses facing up to prevent damage, scratches and contamination when they are not being worn.

Using Eyewashes and Emergency Showers

Eyewashes and emergency showers:

- Are used to flush contaminants from your eyes, face or body
- Are a form of first aid equipment to be used in the event of an accident
- Are NOT a substitute for safety precautions and good work practices
- May reduce damage caused by chemicals by immediately flushing
- Must be located close to areas where exposures might occur
- Must function flawlessly, without delay
- Are not used frequently and may become neglected

Safely Using Eyewashes and Emergency Showers

The following are some best practices for eyewashes and emergency showers:

- Get trained
- Help others
- Flush for the appropriate amount of time
    - For most exposures, the recommended flushing time is 15 minutes or longer
    - Check the Safety Data Sheet (SDS) for specific first aid recommendations for each material
- Remove clothing and PPE to flush properly, as needed. If a harmful chemical has been absorbed into your clothing or PPE, begin showering and then remove your clothing/PPE
- Hold eyes open while washing eyes
- Remove contact lenses as soon as possible
- Be aware that wetting dry powders may make chemicals more hazardous

REMEMBER to:

- Refer to manufacturer instructions for your specific eyewashes and emergency showers
- Read the Safety Data Sheet for each material
- Seek qualified medical attention immediately after eyewash or emergency shower use

Recognizing Eyewash and Emergency Neglect

Signs of neglect include:

- Obstructions in the area
- Clogged, broken or missing nozzles
- Inoperable activating valves
- Improper water pressure – too high or low
- Foreign particles in bowls or basins
- Missing nozzle dustcovers
- Low fluid levels in self-contained eyewashes
- Visible debris/discoloration in cleansing solutions

Report issues and ensure that unsafe items are properly corrected.

Correcting Common Eyewash and Emergency Shower Problems

Make them visible and unobstructed by:

- Placing within 10 seconds of the hazard
- Placing them on the same level as the hazard
- Posting signs prominently
- Applying floor markings
- Removing obstructions, as necessary

Maintain them by:

- Keeping nozzles clean (dustcovers help)
- Keeping water clean
- Checking water flow rates (streams meet in the middle of an eyewash, but don't overshoot the bowl; streams should displace nozzle caps if present)
- Ensuring tepid water is used
- Documenting your inspection
    - Typically, test plumbed, fixed units weekly
    - In-depth inspections for code compliance are needed less frequently (e.g., annually)
    - Look for tags/decals before inspecting and update them after

Handwashing Awareness

Handwashing helps stop germs and harmful substances from being passed around. Wash your hands for better health!

Wash Your Hands for Better Health

The eyes, nose and mouth are pathways through which substances enter the body. People frequently touch these body parts and may transfer germs and chemicals without even realizing it.

Germs and chemicals can also get into food and drinks being prepared or consumed.

Handshakes and being in contact with frequently touched surfaces are ways that germs and chemicals pass from one person to another. Things touched by people can transfer germs, for example:

- Doorknobs
- Stairway handrails
- Bathroom sinks
- Subway hand holds
- Money
- Elevator buttons
- Tools
- Children's toys

You cannot see tiny germs and the smallest traces of chemicals. Wash your hands anytime you feel that they might be dirty, but always wash your hands when performing tasks such as:

- Medical care and dental care
- Food handling, food preparation and food service
- Contact with anything potentially unclean (animals, garbage)
- Use of tobacco products, using restrooms, applying cosmetics and lip balm, eating, drinking or consuming medications, and inserting or removing contact lenses

Handwashing Techniques

Hand Sanitizers

Alcohol-based hand sanitizers can be considered in addition to proper handwashing and when handwashing is not possible.

- Use a hand sanitizer with at least 60% alcohol
- Apply the sanitizer to the palm of one hand and rub it all over the surfaces of both hands until your hands are dry

Soap and water are needed when hands are visibly soiled or greasy or when they are contaminated with chemicals or irritants. Hand sanitizers do not eliminate all types of germs, such as norovirus, a major cause of gastroenteritis or stomach flu.

Handwashing Techniques

Follow these handwashing procedures:

1. Wet your hands with clean, running water and lather with soap.

2. Scrub all parts of your hands and under your nails for at least 20 seconds.
3. Rinse them under clean, running water.
4. Dry them using an unused towel or air.

Drying Hands

Drying is critical to reducing recontamination. Dry your hands with a single-use towel. Paper towels are a more hygienic way to dry your hands because they can physically remove contaminants with less chance of recontamination.

Buttons, levers and crank towel dispensers are sources of recontamination. Touch-free faucets, soap dispensers and towel dispensers minimize cross contamination.

Handwashing Tips

The sink, including the faucet controls, may be contaminated. Consider turning on and off the faucet using a dry paper towel.

Wash around and under rings, but know that rings and jewelry may be prohibited in some workplaces. You cannot be sure jewelry isn't harboring germs and other contaminants.

Protect your hands from touching dirty surfaces as you leave the bathroom.

Employers need to determine alternate methods of handwashing if sinks and a public source of cleaning running water are not available. There are options to bring in clean water and set up handwashing stations.

Healthy Skin and Nails

Healthy skin is a barrier to infection, whereas compromised skin is vulnerable, so report any discomfort from handwashing. Gentler soaps may reduce chapping and irritation. Moisturizing lotions may help, but some lotions degrade rubber gloves, so always follow your employer's recommendations. Diligently clean and trim fingernails since they may harbor dirt and germs.

Gloves

Wearing gloves does not replace the need for adequate, effective handwashing!

- Gloves may have small, undetectable defects
- Gloves may be torn during use
- Do not wash your gloves as a way to avoid changing them
- Wash your hands before putting on gloves since bacteria can multiply in the warm environment inside of gloves
- Wash your hands immediately after removing gloves

If you work in a healthcare setting and use disposable gloves, change your gloves after each patient contact and wash your hands after removing your gloves! When you remove your gloves, you may contaminate your hands. Practice proper removal techniques to minimize touching the outside of a glove with your bare hand. Remember also that gloves can pick up bacteria from dirty surfaces and transfer them to food and others. Gloves need to be changed according to your employer's policies and procedures.

Bloodborne Pathogens (BBP)

Bloodborne pathogens (BBPs) are microorganisms that cause disease. BBPs are transmitted through contact with infected blood or other potentially infectious materials (OPIM).

Assume that all blood and OPIM are contaminated and handle them accordingly.

The three BBPs that pose the greatest risk in your workplace are the hepatitis B virus, the hepatitis C virus and the human immunodeficiency virus (HIV). There is NO CURE for hepatitis B or HIV.

Hepatitis B and Hepatitis C
Hepatitis is inflammation of the liver. The two forms that pose the biggest threat in the workplace are hepatitis B and hepatitis C.

Hepatitis B and hepatitis C symptoms include:

- Flu-like symptoms
- Jaundice (yellow skin, mucous membranes or eyes)
- Weakness
- Lack of appetite
- Vomiting, stomach pain, diarrhea
- Liver inflammation/disease/cancer

There is a vaccine available for hepatitis B, but not for hepatitis C.

Human Immunodeficiency Virus (HIV)
HIV attacks the white blood cells that play a major role in the body's immune system. HIV can eventually lead to acquired immunodeficiency syndrome (AIDS). Even without visible HIV symptoms, you can still infect others. There is no vaccine for HIV.

HIV symptoms include:

- Swollen glands
- Chronic fatigue
- Yeast infections
- Night sweats
- Fever
- Diarrhea
- Loss of appetite/weight

Routes of Exposure
Three routes of workplace exposure for BBPs include:

- Puncture wounds
- Open cuts and skin abrasions
- Eyes, nose and mouth

Safe Handling Procedures

Personal Hygiene

Properly cover open cuts and skin abrasions. In potential exposure areas, NEVER:

- Eat
- Drink
- Store food
- Smoke
- Handle contacts
- Apply cosmetics

Wash your hands and exposed skin with soap and running water:

- Immediately after an exposure incident
- After removing gloves or other PPE
- As soon as possible after an alternative hand-washing method

Engineering Controls

Engineering controls isolate or remove BBP hazards from the workplace and are the best ways to reduce your risk of exposure to blood and other potentially infectious materials (OPIM). Examples include sharps disposal containers, biohazard bags and containers, self-sheathing needles and biological safety cabinets.

Personal Protective Equipment (PPE)

Keep the following in mind when handling blood or OPIM:

- Wear gloves when handling blood or OPIM
- Wear eye protection if there's any chance of splash
- Check PPE for tears, holes or punctures
- Ensure PPE is clean and fits properly
- Remove PPE properly to avoid self-contamination
- Place used PPE in the proper containers

Gloves

- Wearing gloves does NOT remove the risk of exposure, just minimizes it
- Watch where you put your gloved hands and make sure all contamination is cleaned and disinfected later
- While you wear gloves, don't touch your eyes, nose or mouth
- Remove gloves properly to avoid self-contamination

Good Housekeeping Practices

Your employer may provide a spill kit or offer more specific guidelines regarding how to clean up blood or OPIM, but here are some general rules to follow:

1. Carefully cover surface spills with paper towels.
2. Gently pour a 10% (or 1-to-10) bleach to water solution over towels/equipment.
3. Allow the bleach solution to remain in place for at least 10 minutes.
4. Disinfect or properly discard any cleanup supplies.

Remember:

- Sharp items go in sharps containers
- Blood, OPIM and medical waste go in infectious waste or biohazard containers
- Do not recap needles unless you have to
- Use a disposal dustpan and broom, tongs or forceps to pick up broken glass

Emergency Procedures for Blood or OPIM Exposure

If you may have been exposed to a BBP, immediately:

- Clean wounds with soap and water
- Flush eyes and mucous membranes with water or normal saline solution for 15 minutes
- Alert and work with your supervisor and any other appropriate personnel
- Complete applicable exposure incident reports

You may also receive:

- Education and access to any additional disease-preventing measures
- Hepatitis B vaccine or booster
- HIV post-exposure treatment
- Blood tests
- Counseling

Vector-Borne Disease Awareness: Mosquitoes, Ticks and Other Pests

Vectors are living organisms that can transmit infectious diseases between humans or from animals to humans.

Vector-borne disease is human illness caused by parasites, viruses and bacteria that are transmitted by vectors/pests. Symptoms of vector-borne diseases include fever, headache, rash, blurred vision, confusion, nausea and many others.

Bloodsucking pests ingest a disease-producing microorganism during a blood meal, and then inject a new host during a future blood meal.

Vector/Pest	Most Active Time	Diseases Carried	Where Are They Found?
Mosquitoes	Day and night	Malaria, yellow fever, West Nile Virus and many others	• Worldwide, except Iceland and Antarctica • Prefer stagnant water
Ticks	Day and night	Lyme disease, Rocky Mountain spotted fever and many others	• All over the world because they can live anywhere their host lives • Found in tall grasses
Triatomine bugs (kissing bugs)	Night, usually to attack sleeping people	Chagas disease	• Southern U.S. and Latin America, not including Caribbean islands • Found in dark crevices
Sand flies	Dusk until dawn	Leishmaniasis	• Parts of Africa, the Middle East, Europe and Asia, as well as parts of Mexico, Central America and South America • Prefer cool, dark and humid spaces
Black flies	During the day when windspeeds are high	River blindness	• Worldwide • Found near clear running water

Mechanical vectors are found worldwide and physically carry (usually on the feet) a disease-contaminated agent and deposit it where a human can ingest it (usually food or drink).

Common mechanical vectors:

- Cockroaches
- Houseflies

Common transmitted diseases:

- Dysentery
- Typhoid fever
- Cholera

Environment

- Inspect your area for:
  - Evidence of insects
  - Places insects like to live
- Make that area less hospitable to pests

Pest Management

- Seal openings
- Establish a barrier
- Eliminate breeding grounds
- Use insecticides as a last resort

Personal Factors

Awareness

- Be aware of the pests that surround areas where you work, live and travel
- Learn about foreign countries you visit – receive recommended vaccines and immunizations
- Inspect your body for tick bites after you have been in grassy areas

Limit Exposure

- Wear long pants and sleeves to limit exposed skin and prevent insect bites
- Wear light-colored clothing
- Apply insect repellent to exposed skin and clothing
  - Do not spray repellent in an enclosed area or near food
  - Never apply repellent to cuts, wounds, or inflamed and irritated skin
  - Spray repellant on the palm of your hand and apply a thin layer to your face
  - Use only enough repellent to lightly cover exposed skin and clothing
  - Apply sunscreen before applying repellent
- Use a fan to repel flying pests
- Use warm-colored LED lights instead of cool-colored LEDs or incandescent bulbs
- Avoid wearing fragrances and using scented laundry or bath products

How to Remove a Tick

1. Gather fine-tip tweezers and rubbing alcohol. If you don't have rubbing alcohol, use soap and water.
2. Using clean hands, clean the area around the tick with rubbing alcohol or soap and water.
   - Do NOT apply alcohol, fingernail polish, petroleum jelly or matches to ticks to remove them. These methods are ineffective and may damage skin or cause the tick to expel infectious fluids into the bite area
3. Use the tweezers to slowly and carefully pull the tick out.
   - Pull the tick straight up to prevent breaking its head or body. Avoid squeezing the body of the tick
   - If the head separates from the body during removal, remove it separately to avoid prolonged inflammation. If needed, enlist help from a medical professional who may also prescribe antibiotic treatment
4. Release the tick into a jar or zip-lock bag and take it to a doctor for testing. If you aren't going to have the tick tested, carefully dispose of it.
5. Clean the bite area and your hands with alcohol or soap and water.
6. For the next several weeks, monitor for a reaction. See a doctor if you experience a rash, fever, fatigue, headache, muscle pain or joint swelling and/or pain.
   - Consult a doctor if Lyme disease is prevalent in the area or if the tick was swollen, which indicates it may have been attached for an extended period. The doctor may prescribe antibiotics in these cases

Report Exposure

- If you think you have a vector-borne disease, do not panic
- If your exposure was at work, report it to your employer
    - Your employer can assess the situation and decide if professional pest control is needed
    - Reporting helps your employer identify controls and is often the first step to obtaining medical treatment. Your employer may monitor your condition to ensure your recovery
- If your symptoms are severe enough to see a doctor, your doctor will report necessary information to the appropriate public health organizations

Heat Stress

How the Body Handles Heat
To get rid of excess heat, our brains tell our bodies to change our blood circulation and produce sweat. Heat stress occurs when our bodies are unable to maintain a safe internal temperature.

Blood Circulation
The heart pumps more blood and the vessels close to our skin expand so that heat leaves the body at the skin's surface. Our muscles and organs may receive less blood while the body is cooling off. We feel weaker, more tired and less alert. Blood may pool in our lower extremities, causing us to faint. Move around to prevent fainting and lie down while recovering.

Sweat
When sweat evaporates, it sends heat away from our bodies. The moisture in humid air makes it harder for sweat to evaporate and move heat away from the body.

Conditions for Heat Stress
Some conditions make it difficult for our body to cool itself, making heat stress more likely. High **humidity** means there is a lot of water in the air that makes it harder for sweat to evaporate off your skin.

Radiant heat is the heat that objects, such as fires, ovens and pavement, give off. Exposure to radiant heat makes it harder for the body to cool down.

Direct sunlight can cause heat stress because you don't have protection from the radiant heat of the sun. When the air is still, it is not moving heat away from you and it is harder for sweat to evaporate.

The **heat index** is a measure of the level of discomfort the average person can expect due to the temperature and humidity of the air.

Exertion is another factor that can increase the likelihood of heat stress. The greater the heat index and the more you exert yourself, the more water you need to drink to replace what you lose from sweating. Light exertion involves sitting or standing with minimal arm and leg movement. Moderate exertion involves actions that require continuous, modest intensity, such as light pushing/pulling or normal walking. Heavy exertion involves intense upper body work, such as carrying loads or sawing.

Health and Safety Concerns
Health Concerns
Medical conditions, medications and supplements may make people more sensitive to sun damage and heat stress. Read the labels on everything you take and consult a doctor if you have questions or concerns.

Disorder	Description and Symptoms	Treatment
Sunburn	• Skin is burned by UV rays (strongest in late morning and afternoon) • Can burn even on cloudy days • All skin colors can burn • Overexposure to sun can cause skin cancer	• Keep skin **cool and moisturized** as it heals • Wear sunscreen • Protect sunburned skin from further burning • Seek medical attention for severe sunburns, dehydration, high fever and extreme pain
Heat rash	• Also known as prickly heat • Likely in hot, humid environments • Sweat ducts become plugged • Uncomfortable **skin rash** • Discomfort may reduce work performance	• Keep skin **cool and dry** • Let skin air-dry after bathing
Heat cramps	• Painful spasms of the muscles due to body's water and salt loss	• Rest briefly and cool down • Drink liquids with salt or electrolytes, such as sports drinks
Heat exhaustion	• Sweat more (clammy, moist skin) • Develop a headache • Notice dark urine • Feel nauseated/dizzy • Faint	• Rest in a cool place and drink liquids • Prompt treatment is important because untreated heat exhaustion could lead to heat stroke

Heat stroke	• Red skin
	• Sweating that suddenly stops
	• Vomiting
	• Rapid heartbeat
	• Confusion/delirium
	• Convulsions
	• Loss of consciousness
	• **Death can occur**
		• Get medical help **immediately**
		• While you wait for help:
		  ○ Move victim to cool area
		  ○ Remove unnecessary clothing
		  ○ Soak person/clothing with water
		  ○ Fan their body
		  ○ If possible, give them fluids and help them to drink
		• Do NOT give the victim aspirin or acetaminophen

Long-term, prolonged exposure to heat can cause swelling and permanent damage to body's tissues and organs. People who have underlying medical conditions are at an increased risk for heat exhaustion, heat stroke and organ damage or failure. Talk to your physician about any heat stress you may experience on the job and work with your employer to make sure you can work safely.

Safety Concerns

Sweat may cause slips. Heat lowers alertness. Irritability can distract and people may rush and overlook safety procedures to get out of the heat.

Reducing the Likelihood of Heat Stress
Use the hierarchy of controls to avoid heat stress.

1. To **eliminate** sources of heat, your employer may seal steam/heat leaks or intrusions.
2. **Substitution** may involve using alternative processes that produce less heat such as cutting pipes manually rather than using torches. Substitution may also involve using equipment to perform manual tasks, such as lifting or material handling.
3. **Engineering controls** may include air conditioning, canopies, tents or umbrellas, fans/blowers (if heat can escape the area), misters and seat coolers, insulation, windows and ventilation.
4. As an **administrative control**, your employer should have a written program that explains how to prevent heat stress and respond to emergencies. Other administrative controls include letting people work in the shade, scheduling shifts to reduce heat exposure time, enforcing mandatory breaks, medical monitoring, and requiring people to work pairs or groups.
5. **Personal protective equipment (PPE)** may include insulated suits, heat-reflecting clothing, infrared-reflecting face shields, cooling neck wraps, cooling packs or inserts for liners or pockets, and cooling vests. Be aware that some types of PPE, such as respirators, impermeable clothing and head coverings, can increase the risk of heat-related illness.

Bring and use sunscreen, wide-brimmed hats, sunglasses, protective clothing and bottled water when working outside.

Heat disorders are more likely among people who are not used to or acclimated to heat. It takes 4 to 14 days to get used to heat. If possible, **increase heat exposure gradually** over this time. When temperatures jump 10 °F (5 °C) from the previous 5-day period, be prepared for heat stress.

Make hot jobs easier, **lessen job duration**, **take frequent short breaks**, and **postpone non-essential tasks**.

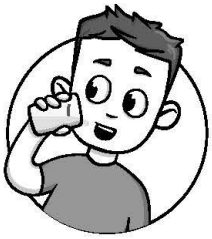
Lifestyle and tasks that are unrelated to work can affect your susceptibility to heat stress. Exhaustion reduces heat tolerance, so get plenty of **sleep**. Eat **small, frequent meals** rather than large meals and choose foods that have higher water content to help reduce internal heat.

Look out for each other and enlist **additional workers** to help perform tasks in the heat more efficiently. When temperatures go above 90 °F (32 °C), make sure people don't work alone or are supervised in case they need help.

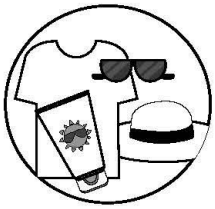
Rest Areas
Take advantage of shade, ventilation and heat shielding to **reduce the heat around you**. When work happens at or above 80 °F (26.6 °C), employers may provide rest areas under trees or in shelters. If you need to rest outside of regularly scheduled breaks, alert your supervisor. Do not return to work until you feel sufficiently cooled and confident that you can do so safely.

HEAT STRESS

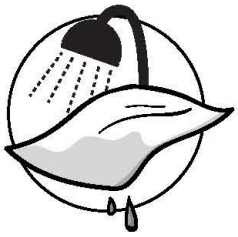
Prevention



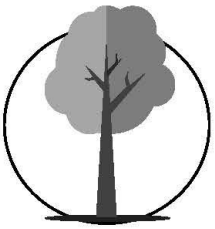
Stay hydrated



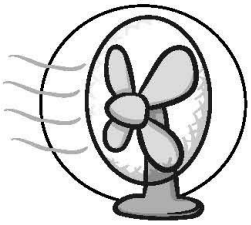
Sun protection



Cold compress/ shower

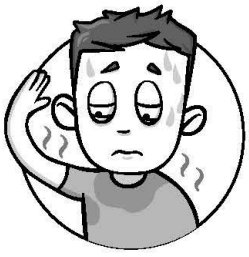


Take breaks in the shade

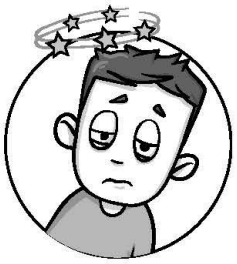


Use a fan

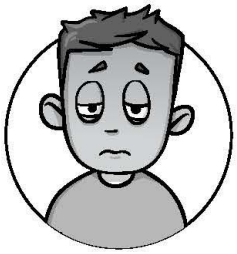
Symptoms



Heavy sweating



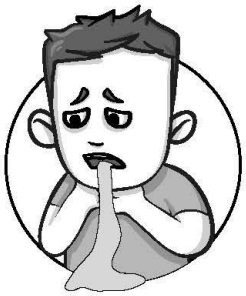
Dizziness



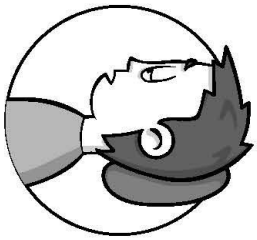
Red skin

Nausea

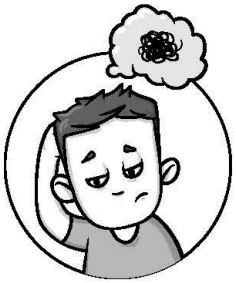
Call for medical advice if...



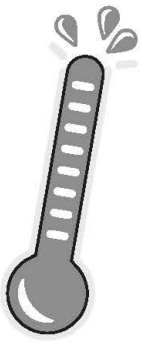
Vomiting



Fainting or unconscious



Confusion



Cold Stress

Whenever temperatures drop decidedly below normal for your region, and as wind speed increases, heat can leave your body more rapidly. **Cold stress** is the loss of body heat to the environment.

Sources of Heat Loss

- **Radiation** - loss of heat to cold air (heat is lost through uncovered head)
- **Conduction** - loss of heat due to contact with something cold (use insulated tools to prevent conduction heat loss)
- **Convection** - transfer of heat from a hot area to a cooler area (such as wind chill)
- **Evaporation** - heat lost from sweating and respiration (increased susceptibility to hypothermia and other cold injuries)

When You Are Exposed to Extreme Cold

Watch for these symptoms that someone is too cold:

- Decreased alertness
- Loss of mobility/dexterity
- Feeling extremely tired
- Feeling effects of cold more quickly
- Slurred words
- Clumsiness
- Irritability or anger

When it is cold:

- Don't rush to get out of cold
- Safety glasses can fog up
- Snow, rain and sleet increase the risk of slips, trips and falls
- Remember that heaters increase the risk for fires or carbon monoxide poisoning

Hypothermia

Hypothermia occurs when someone has an abnormally low body temperature.

Symptoms	Treatment
• Unable to move well or think clearly • Disorientation • Intense shivering • Exhaustion or drowsiness • Confusion or memory loss • Slurred speech • Euphoria • Collapsing	• Immediate medical attention • Bring the person to a warm room or shelter • Remove any wet clothing • Warm the center of the body first – chest, neck, head, groin, armpits – using skin-to-skin contact under loose dry layers of blankets, clothing, towels, sheets, hot packs or warm bottles • Provide warm beverages only if the person is conscious • Perform CPR, if needed • **DO NOT** immerse hypothermic individuals in warm or hot water. It may stop a victim's heart.

Frostbite and Trench Foot
Frostbite occurs when skin tissue freezes. The nose, ears, cheeks, chin, and fingers or toes are most susceptible. Damage can be permanent. Trench foot occurs when you combine cold with water exposure. Keep feet/shoes/socks dry to avoid trench foot.

Symptoms	Treatment
• An initial burning sensation • Coldness, numbness or tingling • White or grayish-yellow skin • Skin that feels unusually firm or waxy	• Seek medical attention as soon as possible • Get into a warm room as soon as possible • Do not walk on frostbitten feet or toes, if possible • Immerse area in warm – **not hot** – water • Warm the affected area using body heat • **DO NOT** rub/massage area • **DO NOT** expose the area to a heat source (heat pad/lamp, fire, stove, etc.)

Factors that Contribute to Cold Stress
Cold stress is more likely with sudden weather changes and if you have pre-existing health conditions or diseases. Some other factors that may impact how cold affects you are:

- Your age and health
- The activity you are doing
- The temperature
- The wind chill

Prevent Cold Stress
Use the following work practices to minimize cold stress:

- Create wind/warming shelters
- Gradually build up your time in the cold
- Take rest breaks in warm areas
- Schedule work at warmer times
- Avoid metal chairs and tools
- Stay hydrated by drinking warm, sweet drinks or broths
- Increase your food energy intake (i.e., more calories/kilocalories/kilojoules)
- Limit or stop use of nicotine, caffeine and alcohol
- Monitor how medicine impacts your response to cold

Clothing

- Keep your clothes dry
- Dress in layers
  - **Inner layer**: Use materials like wool, silk or polypropylene that draw moisture away and tend to hold more body heat than cotton
  - **Middle layer**: Use well-insulated material or wool that provides warmth without weight
  - **Outer layer**. Wear material that protects against water and wind. Wear a hat! Remember that you lose body heat through your uncovered head. Protect your hands by wearing insulated gloves

Confined Spaces: Construction Requirements

The requirements that apply to a confined space task depend on whether the task meets the criteria to be labeled as construction or general industry. It's important that you understand this distinction and how it affects the requirements that are in place to protect workers.

Construction Tasks in Confined Spaces
A confined space is large enough and designed/configured so that people may enter, has limited or restricted entries or exits, and is NOT designed for continuous occupancy. A confined space that contains ANY hazard requires a permit.

Construction tasks create or change a confined space. They include construction, alteration and repair tasks, including painting and decorating. General industry tasks are maintenance activities that do not change the space or its conditions. Construction activities in confined spaces require more safety measures than general industry activities.

NOTE: The requirements you must use depend on your location and the work you perform in the confined space. For example, in the United States, 29 CFR 1926.1201 contains confined space requirements for construction and 29 CFR 1910.146 contains confined space requirements for general industry.

Employers are responsible for determining if activities in confined spaces must follow the requirements for construction or general industry. When an employer has workers who perform both construction and general tasks work in confined spaces, they must follow the more stringent construction requirements. If you have concerns, stop work and report them to your supervisor immediately. Failure to follow appropriate requirements puts people at risk and can result in serious fines and legal actions.

Key Requirements for Construction Tasks in Permit-Required Confined Spaces
The key requirements for construction tasks in permit-required confined spaces are:

- Evaluating the confined space
- Assigning a qualified person
- Continuously monitoring permit-required confined spaces for atmospheric and engulfment hazards
- Suspending permits
- Working with multiple employers at the worksite
- Monitoring the availability of emergency services

NOTE: These are general requirements. The exact requirements may vary based on your location and activities. Please ask your supervisor or safety professional if you have questions.

Evaluating the Confined Space
Construction activities require a competent person to evaluate the worksite and identify confined spaces. The competent person has the skill and authority to identify existing and potential hazards in confined spaces. The competent person is often the entry supervisor who

should be involved in entry planning. If the space has hazards that require isolation, it must have physical barriers that separate people from hazards.

Qualified Person
For construction activities, the entry supervisor of a permit-required confined space must be a qualified person who is trained and equipped per relevant standards to fulfill the role. A qualified person (or entry supervisor) must also reevaluate and reclassify confined spaces that contain construction activities, as needed.

Continuous Monitoring
Construction activities in permit-required confined spaces require that a qualified attendant continuously monitor the space for atmospheric conditions and engulfment hazards. Engulfment hazards are those that can submerge, drown or bury a person. As an example of continuous monitoring, construction work in a storm sewer requires a qualified attendant to test the atmosphere before, during and after entry. Observers or devices may monitor conditions outside the space, such as a connected stormwater drain that could cause a flash flooding engulfment hazard.

Suspension of Permits
For construction activities in permit-required confined spaces, we can suspend the permit if we return the space to the entry conditions listed on the permit before re-entry. If that is not possible, we must cancel the permit. If there is any doubt, it is best to cancel the permit instead of suspending it for added safety and to ensure compliance.

Multiple Employers on the Worksite
Construction projects frequently have specialized professionals on the site who are there as contractors or subcontractors. People working outside the confined space must not introduce new hazards into the space. For example, don't run a generator or gas-powered equipment near the entrance of a confined space because it can cause carbon monoxide to enter the space.

The **host employer** must communicate with other employers at the worksite about:

- Confined space locations
- Actual and potential risks and hazards
- Any new or changing hazards
- Precautions and controls required to enter the space

The **host employer**, **controlling contractor** and **entry employer** must coordinate with each other when multiple parties enter the same confined space and when the permit will be suspended or canceled.

Availability of Emergency Services
For construction activities in permit-required confined spaces, employers who are relying on local emergency services for emergency response must arrange for responders to give them advance notice if they will be unable to respond. Do NOT plan to call local emergency services for confined space emergencies without discussing it with them first.

Hydrogen Sulfide (H_2S) Awareness

What Is Hydrogen Sulfide?
Hydrogen sulfide (H_2S) is a toxic, potentially deadly gas that is formed in nature when organic materials decay. Hydrogen sulfide is also a by-product of various industrial and chemical processes.

It is colorless. It smells like rotten eggs and is sometimes called sour gas, swamp gas or sewer gas. **Even though it has a distinct odor, it can instantly inhibit your sense of smell so that you cannot detect it.**

Hydrogen sulfide is heavier than air, so you should expect to find it in low areas, especially sewer lines, pits and cellars.

If you ignite hydrogen sulfide, the fire will flash back to the source of the gas.

Health Effects
Since hydrogen sulfide can impair your sense of smell, the first indication you may notice is burning or irritation of the eyes, throat and respiratory tract. This may cause you to cough, have a metallic taste in your mouth, cause your eyes to burn or water, give you a headache, and make you feel sleepy.

Hydrogen sulfide is both an irritant and a chemical asphyxiant and poses several health effects, such as:

- Temporary loss of your sense of smell
- Metallic taste
- Headache
- Labored breathing
- Unconsciousness
- Asphyxiation (can cause brain damage, cardiac arrest even death)

IMPORTANT:	In high concentrations, hydrogen sulfide can cause IMMEDIATE unconsciousness followed by death.

What Protection Should I Use?
Your employer may require tests to check the atmosphere where hydrogen sulfide may be present.

Use atmosphere-supplying respirators like SCBAs and air-line respirators that provide clean air from a bottled source or breathing air compressor.

Escape-only air packs may be available for you to use ONLY when exiting a toxic atmosphere.

You should receive additional training about respiratory protection, a fit test and a medical evaluation BEFORE you use any respiratory equipment.

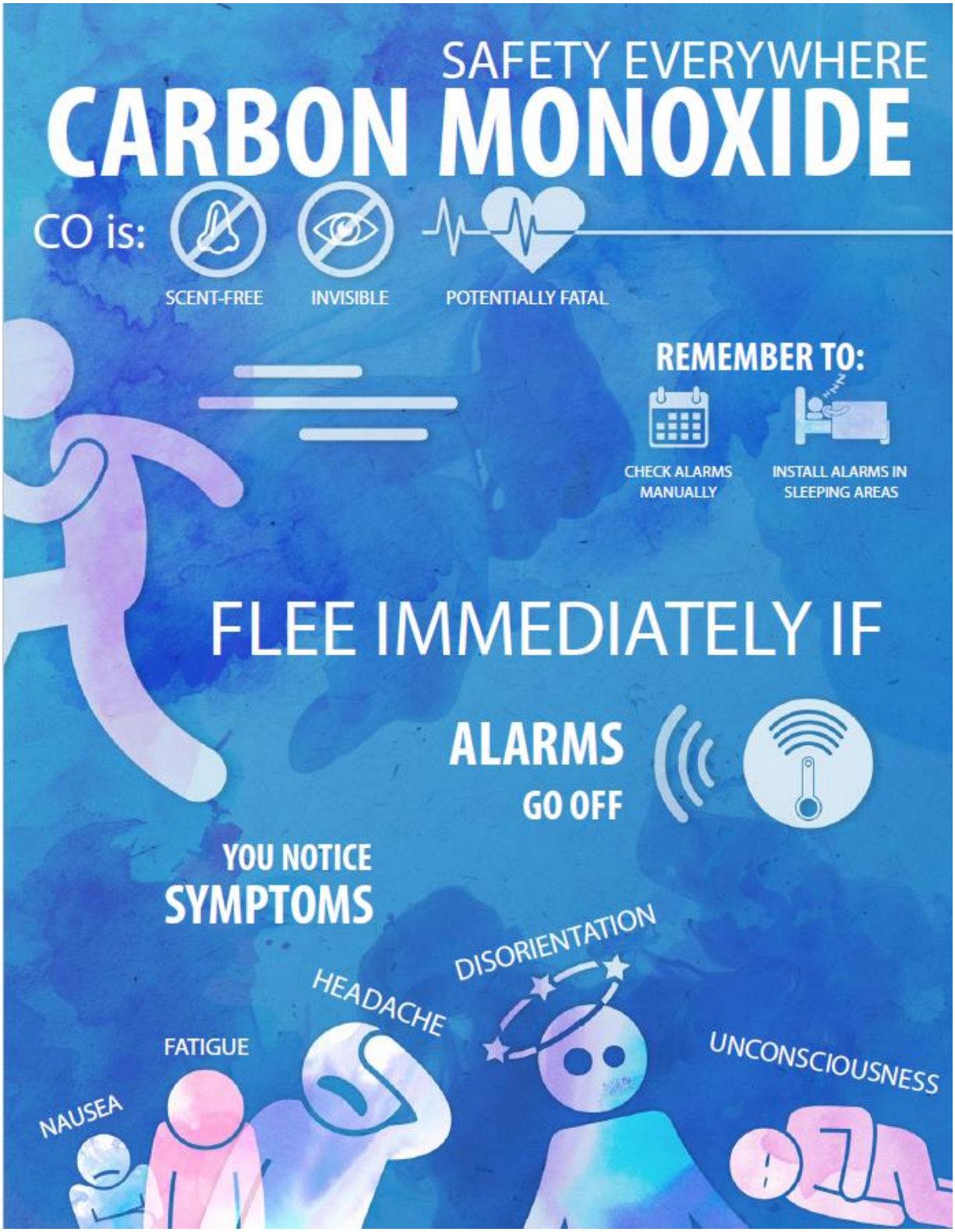
What Should I Do?
You should receive training about the emergency response plan for your employer and location.

If you suspect hydrogen sulfide is present:

1. ENSURE YOUR OWN SAFETY.
2. Call for assistance.
3. Wear an atmosphere-supplying respirator (NOT an escape-only air pack).
4. Move the victim to a safe area with fresh air.
5. Begin cardiopulmonary resuscitation (CPR).
6. Get professional medical care for the victim as soon as possible.

Do NOT attempt a rescue unless you are qualified to wear respiratory protection and perform rescue tasks.

Safety Everywhere: Carbon Monoxide



Sources of Carbon Monoxide

Which of these do you have in or around your home?

- Gas appliances, such as:
  - Furnace/boiler
  - Water heater
  - Oven/range/stove
- Car, truck or other vehicle
- Fuel-powered equipment, such as:
  - Lawn mower
  - Leaf blower
  - Chainsaw
- Wood-burning or outdoor cooking/heating sources, such as:
  - Fireplace
  - Wood-burning stove
  - Portable gas stove or camping stove
  - Charcoal grill
  - Portable, flameless chemical heater
- Portable generator

Staying Safe: Gas Appliances

– Have appliances serviced by a technician every year
– Ventilate them properly
– Never use a gas oven to heat a home
– Never patch a vent pipe with tape, gum or anything else not intended for that purpose

Staying Safe: Fuel-powered Equipment

– Buy only equipment carrying the seal of an international testing agency, such as UL
– Do not leave equipment or vehicles running in enclosed spaces such as garages or sheds

Staying Safe: Fireplaces and Outdoors

– Inspect and clean fireplaces and wood-burning stoves yearly
– Never use portable camping stoves, charcoal grills or portable, flameless chemical heaters indoors

Staying Safe: Portable Generators

– Never use a generator inside your home, basement or garage
– Place generators at least 6 meters (20 feet) from windows, doors or vents

HAZWOPER: Direct Reading Gas Detector Safety

Gases may be invisible or odorless. Even small amounts of some gases can be dangerous, rendering people ill or unconscious or causing dangerous fires or explosions. Direct reading gas detectors can provide life-saving data when you use them properly.

NOTE: Your employer will provide you with hands-on training about the specific equipment you will use. Your training may include reviewing manufacturer manuals or guides and practicing.

Purpose and Function of Direct Reading Gas Detectors
Direct reading gas detectors help us identify and monitor gases that are asphyxiating, flammable/combustible, and toxic. The number of gases that direct reading gas detectors test for varies.

HAZWOPER responders use detectors to evaluate atmospheres and verify safe conditions. Detectors must be accurate (real-time measurements), durable (rugged, waterproof), reliable (audible/visual alarms) and routinely calibrated (daily and periodically).

Some direct reading gas detectors are permanently installed in a fixed location where employers know gas may be present. Most HAZWOPER operations use **portable detectors**:

- Area monitors (lightweight and easy to carry)
- Hand-held, wearable or clip-on (compact and attach to clothing)

Single-use, disposable detectors or badges usually detect one specific chemical and do not offer the full range of protection that HAZWOPER responders need.

Maintenance, Care and Storage
It is vital to ensure that detectors function as expected and relay accurate information BEFORE you use them to protect people and property. Your employer has dedicated equipment, such as gases, devices and stations, that you will use to perform detector testing and calibration. Keep a record of testing activities, results and corrective actions.

During **functional testing**, the user exposes the sensor to gas at a specific, known concentration in a safe environment to ensure that the alarm activates as expected. If the alarm does not activate, it may not be calibrated correctly, there may be interference or there may be another problem with the detector. Follow your company's procedures, which may include resolving the problem and completing a full calibration or tagging the detector as out of service until repairs are complete.

NOTE: In the United States, functional testing is sometimes called "bump testing."

We perform **calibration** activities to ensure detectors are accurate. Calibration checks verify accuracy by exposing detectors to a known amount of gas. Full calibrations require the user to adjust the detector's readings to match known concentrations of test gases.

Factors that can cause detectors to be inaccurate include the age of the detector and specific sensors, operating conditions, their saturation in chemical environments, physical damage, temperature and humidity, and vibration or shock.

Follow guidance from the manufacturer and your employer about how often to complete functional testing and calibration. For example, your employer may require you to do a functional test and calibration check every day prior to using the detector.

If the detector fails, your employer may require repairs followed by a full calibration and another functional test before anyone may use the detector. Some devices may lock and become unusable when functional or calibration testing are due.

Detectors are sensitive, intrinsically safe instruments. Treat them with care. Gas detector sensors can be damaged by chemicals in cleaning and disinfecting products. Follow manufacturer recommendations for **cleaning**, which may include using a cloth dampened with soap and water and doing functional testing and calibration checks afterward.

Store detectors away from heat/sunlight, water/humidity and chemicals. When you take a detector out of storage, check the battery level and perform functional testing and a calibration check prior to use.

Using Direct Reading Gas Detectors

Your employer must train you about the specific detector you will use. Detectors have gas parameters at which alarms will activate. Follow your employer's instructions about setting and checking these parameters.

Always test detectors in a clean and safe environment. Check the required calibration date, which is usually on a sticker on the detector or in the detector's start-up display. Perform functional (bump) testing with a known amount of calibration gas at a designated area or docking station. Review the testing log for any notes or abnormalities. Sensors are sensitive to temperature, humidity and contamination.

If the detector fails the functional test by receiving a reading outside the allowable margin of error, you may need to replace the sensor.

Make sure detectors have enough power to function for the duration of the HAZWOPER operation. If the detector has a clip, make sure it is functioning properly and secures tightly.

Verify that the detector is safe to use in the intended atmosphere. Most detectors are safe to operate in combustible atmospheres.

Test for oxygen and flammable gases and vapors first. Then, test for toxic atmospheres. Fluctuations in readings may indicate that a hazard is present or that conditions are interfering with the accuracy of the detector.

Sampling

There are two ways HAZWOPER responders will use their detectors: sampling and diffusion. Detectors perform **sampling** by pumping in air from a tube or line, testing it, and then expelling it through a vent.

Sampling allows responders to check the air before they enter, and it allows others to monitor conditions remotely. Be aware that sample readings are not immediate. It may take 1-2 minutes for the detector to draw in air and test for gases depending on the length of the sampling probe

Confined or enclosed spaces may have **stratified atmospheres** that have varying concentrations of gas. To sample them accurately, you must move the tubing attached to the pump to various levels. Start at the lowest or farthest point that a person may be able to reach and sample for 1-2 minutes. Then, move a few feet (about a meter) and sample again for 1-2 minutes. For vertical spaces, remember to check atmospheric conditions in the breathing zone, which is typically 3-7 feet (1-2 meters) above the working surface.

Do not place the sampling probe or tubing into highly concentrated atmospheres. Avoid pulling liquid into the sampling port. When monitoring, take note of any fluctuations in the readings, especially for oxygen, which can increase or decrease to dangerous levels depending on the work or chemical reactions taking place.

Diffusion

In **diffusion** mode, detectors passively sample the air without suction. Hold or attach detectors in the breathing zone that is the 10 inches (25 centimeters) around the mouth and nose. Do not cover detectors or place them inside clothing or pockets.

Flammable and Combustible Liquids

Flammable and Combustible Liquid Danger

- Flammable and combustible liquids tend to let off vapors that mix with the air, where oxygen makes them ignitable
- Each liquid is classified by its **flashpoint** – the lowest temperature at which its vapors reach an ignitable concentration in the air
- Temperatures hotter than the flashpoint cause more evaporation, making the liquid even more dangerous
- Flammable liquids have lower flashpoints than combustible liquids (ignitable vapors are possible at lower temperatures)
- A flammable liquid has a flashpoint under 100 °F (38 °C)
    - Gasoline, or petrol, for instance, has a flashpoint of about -45 °F (-43 °C), so its vapors can ignite on even an extremely cold day
    - Common flammable liquids include acetone, benzene, ethanol and petrol
- Combustible liquids have flashpoints at or above 100 °F (38 °C) and below 199 °F (93 °C)
    - Common combustible liquids include diesel fuel, motor oil, kerosene, and oil-based paints

Flammable and combustible liquid vapors:

- Often settle in low-lying areas
- Can travel to connect liquids to ignition sources (flashback)
- May also be toxic, corrosive or otherwise hazardous
- May cause dangerous chemical reactions, such as with oxidizers

Contact with flammable and combustible liquids and vapors causes skin and eye irritation. Flammable and combustible liquids and vapors are also commonly toxic. Symptoms of inhalation, ingestion and skin absorption include headaches; lightheadedness and dizziness; nausea and/or vomiting; confusion and mood changes; and difficulty breathing.

Labels on containers of flammable and combustible liquids have a GHS pictogram of a flame inside a red diamond. Labels may also include the words FLAMMABLE or COMBUSTIBLE. DANGER indicates more severe hazards than WARNING. You can also find information about flammable and combustible liquids in the Safety Data Sheet (SDS).

General Safety Procedures

To prevent or extinguish fires, essentially remove any one of the components of fire (fire, heat, oxygen, and chemical chain reaction).

Keep ignition sources away from flammable and combustible liquids. Ignition sources include:

- Open flames
- Cigarettes
- Lightning
- Static electricity
- Friction
- Cutting

- Welding
- Grinding
- Radiant heat
- Electrical arcing or sparks
- Mechanical sparks
- Heat-producing chemical reactions

Bonding and Grounding

Use bonding and grounding to prevent static electricity. Bonding and grounding only work when you create an electrically continuous (e.g., metal-to-metal) connection.

- **Bonding**: Connecting objects with wire so that electrons that move between the objects will travel through the wire, not the air
- **Grounding**: Creating a metallic path between an object and the ground

Proper Storage

Storage rooms for flammable and combustible materials:

- Have ventilation systems that prevent flammable vapors from accumulating to unsafe levels
- Are liquid-tight where the walls meet the floor
- Have varying capacity limits that people must not exceed (ask your supervisor)
- Are NOT safe if you keep too much in them (observe limits set by your company)
- Should have fire protection systems, such as overhead sprinklers

Flammable and Combustible Liquid Cabinets

Cabinets should:

- Be conspicuously labeled "Flammable – Keep Fire Away"
- Be able to pass a standard fire test and have special fire-resistant features

Flammable and Combustible Liquid Outside of Storage/Cabinets

The amount of flammable or combustible liquid that can be outside of a storage room, cabinet or fire area depends on the liquid and type of container, as well as on applicable regulations. **The less you have out, the safer you are.** The more dangerous the liquid, the less you should have out at one time. Follow your company's policies. Take only what you need for a task, half-shift or shift and always put it back in the storage room or cabinet as soon as you are done with it.

Containers

- Choose containers designed, constructed and/or listed to meet the safety standards of appropriate safety organizations
- **Safety cans** often have spring-closing lids and spout covers to prevent vapor from escaping, prevent over-pressurization, and may also have flame arrester screens

Safety Principles and Procedures

Transferring Flammable and Combustible Liquids

It is best to only transfer flammable and combustible liquids by using:

- Safety cans
- A closed piping system

- An approved self-closing safety faucet
- Or a safety pump

Bond and ground your containers when you transfer flammable and combustible liquids!

Minimize the rate and height at which you pour to limit air mixing, splashing and static charge. Leave free space in containers to allow for liquids to expand without overflowing; this will help prevent leaks or ruptures.

Housekeeping

Even very small amounts of flammable and combustible liquids can give off enough vapor to form an explosive atmosphere inside containers. Flammable and combustible liquids can easily be trapped in a seam or be present as a very thin film on the inner surface of containers or drums. Welding, cutting, drilling, or opening drums with spark-producing tools can lead to vapor flash fires and deadly explosions.

Keep storage rooms, cabinets and your work area tidy, close containers and cabinets immediately, and put liquids back after use.

Know your company's procedures for reporting and cleaning up spills BEFORE you begin working. Ask your supervisor if you have questions. Only employees who are qualified to clean up spills should do so. Prompt cleanup by qualified people can help prevent hazard exposures and fast-spreading fires. Large spills and the materials that responders used to clean them up can present serious fire, explosion and health hazards. Make sure responders are aware of the liquids involved and have relevant Safety Data Sheets (SDSs).

Appropriate fire control devices, such as appropriately rated fire extinguishers and hoses, should be available where flammable and combustible liquids are stored. Only extinguish fires if you are properly trained to do so.

Fire Extinguisher Safety for Construction: Fight or Flee

One of the most important things you need to know about fire extinguishers is when to use them and when NOT to use them.

Every fire has unique challenges and every extinguisher has limitations.

Know the Risks
Fighting a fire can stop its spread and keep evacuation routes clear, but there are risks. Fires can increase in size and intensity in SECONDS, blocking exit paths and creating a hazardous atmosphere. Portable fire extinguishers contain a limited amount of extinguishing agent and can be discharged in a matter of SECONDS.

Fight or Flee?
Ask yourself:

- Is the fire too big for a portable fire extinguisher?
- Is the environment too hot and smoky, making it difficult to breathe?
- Is there a safe evacuation route?
- Do you know the fire size and is any of it hidden (behind walls/ceilings)?

You may be able to **FIGHT** the fire:

- The fire just started and is limited to the original material ignited
- There is a clear evacuation path behind you

You may need to **FLEE** if:

- The fire involves a large amount of flammable solvents
- Heat is too intense to get within 10-15 feet (3-4.5 meters) of the fire
- Smoke is quickly filling the area
- You must crawl on the ground due to heat or smoke

REMEMBER: If the fire is not contained and fire, heat or smoke may block the evacuation path, flee as quickly as possible.

Fire-Fighting Overview

IMPORTANT: To effectively use fire extinguishers, you need additional training and hands-on practice. This is just to give you an overview of best practices for fighting fires.

In general:

- Activate the emergency plan and clear the area
- Fight the fire if it is safe to do so
- If the fire becomes too dangerous or you are unable to put it out, evacuate immediately
- Use the **PASS** method
    - **P**ull the pin
    - **A**im the the nozzle
    - **S**queeze the trigger
- **S**weep the nozzle side to side at the base of the fire

Fire Extinguisher Safety for Construction: Using Extinguishers

To effectively put out small fires, you need to CHOOSE and USE the right extinguishers.

How Fire Extinguishers Work
For fire to exist, the following elements must be present at the same time:

- Heat
- Oxygen
- Fuel
- Chemical chain reaction

Fire extinguishers expel extinguishing agents when you press down on their handles.

The extinguishing agent will do one of the following:

- Cool burning fuel
- Displace or remove oxygen
- Stop the chemical reaction so a fire cannot continue to burn

Fire Extinguisher Types
Using the wrong extinguisher can be ineffective and may make the fire worse or cause new hazards.

- **Class A** fires involve ordinary combustibles such as paper, cloth, cardboard and wood. They require extinguishers labeled A, such as air-pressurized water and foam extinguishers. While portable fire extinguishers are the primary focus of this course, it's worth noting that water hoses and water barrel and bucket approaches may also qualify as Class A means to extinguish site fires.
- **Class B** fires involve flammable liquids such as gasoline, oil, grease, paint, lacquer and solvents. Carbon dioxide, or CO2, extinguishers are an example of class B and C extinguishers.
- **Class C** fires involve electrical equipment such as wiring, fuse boxes, energized electronics, motors, appliances, computers and other electrical sources. Halogen or clean agent extinguishers are an example of class B and C extinguishers.
- **Class D** combustible metals – such as aluminum, magnesium, titanium and sodium – require special extinguishers labeled D, such as dry powder extinguishers.
- **Class K** fires involve cooking oils and greases such as animal fats and vegetable fats. They require a wet chemical extinguisher labeled K. Class K extinguishers are commonly mounted in or near a commercial kitchen and discharge automatically.

Heat and embers from Class A combustibles, such as scrap wood, sawdust and similar materials, can be difficult to extinguish completely. Just as campfires often re-ignite, these jobsite combustibles may do the same. Drench and monitor extinguished materials until re-ignition is no longer a threat.

Fire-Fighting Overview

IMPORTANT: To effectively use fire extinguishers, you need additional training and hands-on practice. This is an OVERVIEW of best practices for fighting fires.

1. Alert others of the fire by whatever accessible means you can and ask someone to notify the appropriate people, such as the fire department and site security.
2. Evacuate the immediate area.
3. Notify others of your intent.
4. Identify a safe evacuation path.
5. Choose the appropriate type of fire extinguisher.
6. Stand a safe distance from the flames (check extinguisher label).
7. Discharge the extinguisher using the PASS (pull, aim, squeeze and sweep) technique.
8. Back away from the extinguished fire.

If the fire becomes too dangerous or you are unable to put it out, evacuate immediately.

PASS Method

To use the PASS method:

1. PULL the pin.
2. AIM toward the base of the fire.
3. SQUEEZE the handle.
4. SWEEP from side to side at the base of the fire.

Watch the area. If the fire re-ignites, repeat the aim, squeeze and sweep steps.

Best Practices

Be sure to:

- Seek hands-on training in addition to the online course and this job aid
- Keep the right class of extinguisher for the materials in each area
- Make sure extinguishers are accessible and easy to locate
- Always maintain clear access to fire extinguishers and other emergency equipment
- Don't stack materials in front of extinguishers
- Document periodic extinguisher inspections
- Inspect the pin, gauge and nozzle for damage, obstructions or evidence of tampering
- NEVER re-mount a used extinguisher

Compressed Gas Cylinder Safety

Hazards
A highly pressurized container may become a:
- Projectile
- Fragmentation bomb

Tipped or dropped cylinders can crush fingers and limbs.

Chemical hazards may also present:
- Reactions between incompatible gases
- Toxicity/Poisoning
- Asphyxiation

Identification
Before beginning any work with compressed gas, always identify the contents of a cylinder. Read the label; the cylinder must be stenciled, stamped or labeled. NEVER rely on cylinder color! Cylinder color varies depending on the region and supplier. If in doubt, do not use the cylinder! Do NOT rely on valve-cap color because valve caps are often interchangeable; the valve cap on a cylinder may not belong on that cylinder.

Gas Types and Hazards
- *Asphyxiant*: Reduce or remove breathable oxygen
- *Inert*: Main hazardous property is asphyxiation
- *Flammable*: Burn or explode in the presence of an ignition source
- *Pyrophoric*: Self-ignite, burn, or explode in the presence of air
- *Oxidizer*: Support vigorous burning of other materials
- *Toxic or Poisonous*: Hazardous to health in small quantities
- *Corrosive*: Begin destroying materials on contact

Gases often present multiple hazards.

Cylinder Storage
Environment
Always store cylinders:
- In a well-protected, well-ventilated, dry location
- Protected from collisions with vehicles, moving equipment, elevators, stairs
- On smooth, level floor with a means for securement
- Free from materials that might catch fire

Temperature
Keep cylinders away from temperature extremes and ignition sources. Never allow the temperature to rise above 52° Celsius (125° Fahrenheit). Concrete and asphalt surfaces absorb radiant heat making them significantly warmer than ambient air temperatures. Gas suppliers may recommend storage in shaded areas to prevent overheating.

Segregation

Store incompatible gases by hazard class in separate areas

- This includes empty cylinders, which may contain small amounts of gas
- Store upright and at least 6 meters (20 feet) from highly combustible materials
- Oxygen cylinders (full or empty) must never be stored near flammable gases and materials
    - A minimum separation of 6 meters (20 feet) must be maintained
    - Some jurisdictions allow the placement of a firewall between storage areas when distance requirements cannot be met
    - Never place greasy or oily materials near oxygen
- Always refer to the gas supplier's specific recommendations

Restraints and Signs

Secure the cylinder at all times to a wall, holding cage, heavy workbench or lab bench, or no-tip base. Fasten restraints on the upper half of the cylinder, above the center of gravity.

Post signs identifying the substances and appropriate precautions in all areas where flammable compressed gases are stored, for example:

- "Hydrogen"
- "Flammable Gas"
- "No Smoking"
- "No Open Flames"

Handling and Transportation

Before handling any compressed gas cylinder, locate the Safety Data Sheet (SDS) for the gas you will be using. This document contains vital information that you need to keep in mind such as health effects, first aid for exposure and protective equipment requirements.

Follow these simple guidelines when transporting cylinders:

1. Remove the regulator. Never move a cylinder with the regulator still in place
2. Replace the valve cap. Never lift a cylinder by the valve or protective cap
3. Secure the cylinder to a suitable hand truck or cart in an upright position
4. Never roll a cylinder on its side
5. Never drag or slide the cylinder or strike cylinders against each other
6. Move only one cylinder at a time

Personal protective equipment (PPE) may save your life. Always wear safety glasses and a face shield, especially when connecting and disconnecting regulators and lines. Use gloves or other PPE, if required.

Highly Hazardous Materials

Leaking or damaged gas cylinders or systems and those endangered by fire often present a true emergency. Emergency plans and specially trained responders may be needed. Follow your site's plan. Evacuation may be necessary.

Valve and Regulator Safety

Regulator Safety

Follow these simple steps to avoid hazards:

- Attach the regulator to the cylinder valve outlet
- Turn the delivery pressure adjustment knob counterclockwise
    - Ensure the flow control valve is in the closed position
- Stand to the side and slowly open the cylinder valve until the regulator registers the cylinder pressure
- Turn the delivery pressure adjustment knob clockwise
- Regulators are gas-specific and not necessarily interchangeable
- Always make sure that the regulator and valve fittings are compatible
- Never tighten any fittings while under pressure

Valve Safety

- Valve caps must be on when the cylinder is not in use
- The valve threads may vary in diameter, internal or external, right-handed or left-handed
- Only use standard valves, regulators and fittings that are approved for the particular gas. Do not assemble miscellaneous parts
- Make sure a cylinder's valve is accessible whenever you're working with it
- Never leave the main cylinder valve open when the equipment is unattended or not operating. This prevents cylinder contamination and slow leaks
- Never use pliers to open a cylinder valve!
- Check if the valve requires a washer
- If cylinder or gas system parts are not moving smoothly, DON'T FORCE IT
- Work with your gas supplier to determine appropriate parts and torque values
- Do not use wrenches on handwheels
- Do operate cylinders using a gloved hand
- Discontinue use and contact the supplier if a cylinder valve is difficult to operate
- Leave keys on cylinders when valves are open

Inspections and Repairs

Regularly inspect all cylinders. Check for the following:

- Are there signs of defects?
- Is there any deep rusting?
- Does it contain the correct gas in the designated usage area?
- Is there any dirt, paint, corrosion or other material obstructing the pressure relief device?
- Check all hoses and other equipment for leaks
    - Apply an appropriate leak check solution to check all connections for leaks
    - Never use an open flame to detect leaks

If a leaking cylinder is discovered:

- Move it to a safe place (if it is safe to do so)
- Inform your supervisor
- Remove the cylinder from service
- Repairs should be made by qualified personnel
- Under no circumstances should you attempt to repair a leaking cylinder or valve!

Welding, Cutting and Brazing Part 1: Methods

Welding, cutting and brazing are hot work techniques that workers use to bond, cut, solder or form metals at extremely hot temperatures.

Methods and Hazards
All hot work involves hazards like fires, burns, the potential for heat stress, and other issues associated with extremely hot temperatures. There are hazards that depend on the method and materials involved in welding, cutting and brazing. This job aid will provide an overview of methods and hazards. You will receive additional training from your employer about the specific hazards associated with your work and work area.

In **gas torch welding and cutting**, workers commonly use a torch filled with a fuel gas and oxygen to produce a flame that melts metal. Fuel gases may include acetylene, methylacetylene, hydrogen, propane or propylene. The type of gas can affect this method's hazards in terms of fumes, fire and explosion potential.

Electrical arc welding and cutting uses an electrical arc between the work piece and the welding electrode. It creates a pool of molten metal and commonly involves a protective shield of gas or molten metal to prevent or minimize contact with air. Types of electrical arc welding are distinguished by the types of electrodes and gas shields they use. When performing electrical arc welding, be aware of the dangers of plasma (ionized gas that strikes work pieces with high heat and kinetic energy), ultraviolet (UV) rays or light, inhalation of gases and fumes, and electrical shock.

Brazing involves joining metal items by heating and applying a filler metal with a lower melting point than the work piece.

Common filler **metals** include copper, nickel, aluminum and brass alloys. Be aware that **metals** at hot temperatures can react chemically with elements in the air, such as oxygen and nitrogen, and with ambient temperatures and UV to create dangerous fumes and gases. The type of metal involved in the work piece or in the filler can affect the hazards that may be present.

Your employer will train you about the metals you will work with and their hazards. You may also refer to Safety Data Sheets (SDSs) for information about welding fluxes, solders, consumable electrodes and filler materials.

Gas Torch Welding and Cutting Safety

Pressurized Filler Gas	Fuel Gas
• Oxygen may be combined with fuel gases • Oxygen helps objects burn • Keep gloves, oxygen fittings and connections free from oil or grease because oxygen reacts	• Fuel gases may include acetylene, methylacetylene, hydrogen, propane or propylene • Acetylene is the most common fuel gas • It is very flammable and can ignite at a wide range of concentrations

explosively with these substances • Store oxygen and flammable gases at least 6 meters (20 feet) apart or use a half-hour fire-rated partition at least 1.6 meters (5 feet) tall to separate storage areas	• Acetylene becomes unstable (combusts or explodes) at high pressures, so NEVER use acetylene at pressures above 104 kilopascals (kPa) or 15 pounds per square inch (psi) • Keep acetylene cylinders in an upright position because acetylene is stabilized in acetone liquid that may spill or get into the regulator, line or torch if a cylinder is stored on its side

Before you open welding gas cylinders:

- Ensure there are no ignition sources nearby because they can cause gas to ignite or explode
- Perform a visual pre-use inspection for defects or dirtiness of the torch, lines and regulator to prevent gas leaks, fires and explosions
- Ensure clothing and welding gear are free from oil and grease smears
- Make sure there are no hydrocarbon-based lubricants on the regulator, hose, torch or cylinder valve threads

Note that some cylinders valves require tools, which you should keep nearby for quick adjustments or to stop flow in the event of hose fires or other emergencies. **Stand to the side** of the cylinder outlet and regulator and keep torch nozzles and regulator faces pointed away from your body. Blow out the cylinder valve before connecting the regulator by opening the valve slightly and then closing.

Check for leaks after making new connections by listening for hissing, investigating smells and using leak check solutions to look for bubbles. Do NOT crack open the valves of hydrogen cylinders, even momentarily; the compressed gas can self-ignite in certain conditions. Do NOT vent gases toward yourself or in confined spaces or other areas with limited ventilation.

Before you light a gas welding torch:

- Purge oxygen and fuel gas passages individually by slowly allowing each gas to flow through its respective hose separately
- Keep the tip of the torch pointing away from your body

To safely light a gas welding torch, keep the nozzle pointed away from your body.

1. Release the fuel gas.
2. Light the flame with a long-handled flint striker.
3. Slowly and fully open the oxygen and adjust it down to create the desired flame size.

If you release the oxygen before the fuel gas, you will hear a loud BOOM as the flame ignites. Releasing the fuel gas first allows you to better control the flame and avoid creating a flash fire.

When you finish the job, follow manufacturer instructions for shutting down the gas welding torch. For many torches, the steps are:

1. Close the oxygen gas valve first, then the fuel gas valve.

2. Ensure the valves of both cylinders are fully closed.
3. Open the oxygen gas valve a 1/2 turn and bleed pressure from the line.
4. Close the oxygen torch valve and turn the regulator adjusting screw to the OFF position.
5. Open the fuel gas valve a 1/2 turn and bleed pressure from the line.
6. Close the fuel gas valve and turn the regulator adjusting screw to the outward or OFF position.

Neatly coil the hoses and store the equipment per the manufacturer's instructions.

Electrical Arc Welding and Cutting Safety
Electrical shock CAN cause injury or death. You WILL receive a shock if your body touches both sides of the welding circuit – the electrode and the work piece or welding ground – at the same time.

Follow these electrical arc welding and cutting guidelines:

- Use well-insulated electrode holders and cables that are in good condition
- Keep welding cables, your body and personal protective equipment dry and free of grease and oil
- Keep the working ends of welding cables apart
- Wear dry, hole-free gloves; clothing should also be dry
- Never touch the electrode or metal parts of the electrode holder with skin or wet clothing
- Dry any insulation between your body and metal
- Prevent welding leads from sustaining damage due to equipment rolling over them

Remember: Stick electrodes are always electrified even when you are not welding.

Practices, Positioning and Personal Protective Equipment (PPE)
The job hazard analysis should prescribe the safest welding method and materials. Keep your face as far away from the welding plume as possible. Employers may monitor air quality and use ventilation, exhaust and other measures to reduce exposure to gases and fumes. Position your body to avoid fumes, sparks and molten metal.

SAFE CLOTHING offers some protection from sparks, molten metal, UV exposure and flames:	**UNSAFE CLOTHING** doesn't offer adequate skin protection and may melt/burn:
• Flame-resistant wool, denim, canvas or heavy cotton • Fitted • Long-sleeve shirts, long pants that overlap shoe/boot tops, welding jackets or coveralls	• Many synthetic fibers • Frayed or worn • Unbuttoned cuffs or open pockets • Flammable material such as lighters/matches in pockets and smeared oil/grease/solvents

Personal protective equipment (PPE) is designed to supplement other controls to help protect your skin, hair and eyes from molten metal spatter, sparks and UV. Check the **job hazard analysis** to determine the specific equipment you must wear for each welding task. PPE for welding, cutting or brazing work may include:

- Welding googles or a welding helmet with a cap underneath

- Insulated welding gloves
- Fire-resistant (FR) sleeves
- Fire-resistant or leather cape or shoulder covers (for overhead work)
- Electrically rated leather shoes with safety toes
- A respirator with appropriate medical and fit testing (for some operations)
- Earplugs or earmuffs (for noisy operations and those that generate sparks)

The job hazard analysis should identify welding helmets or goggles that have the appropriate ratings for the potential exposures to UV, impact and heat for the job at hand. Some helmets may have shields that automatically darken or lighten based on light intensity. Refer to the operator's manual for information about any manual adjustments needed for specific welding methods. Never use a helmet if the filter plate or cover lens is cracked or broken.

Welding, Cutting and Brazing Part 2: Physical Hazards

Physical hazards can cause physical damage to people and property and may even kill people. Before you begin welding, cutting or brazing, you need to look for hazards and determine if any special precautions are needed.

Many companies use **job hazard analyses** or other customized **risk assessments** that they update when conditions change. Check the analyses to learn about the hazards associated with the work and how to control hazards. The analyses include hazards and controls for the task you will perform, the tools and materials you will use, and the setting in which you will work. If there is not an analysis for your task, or if conditions change and the analysis requires an update, please notify your supervisor to determine if the analysis needs to be created or updated.

Typical **physical hazards** for welding, cutting and brazing work include:

- Fires and explosions related to hot work and compressed gas cylinders
- Hot torches and metals that can contribute to fires and cause burns to the body
- Electricity from arc welding that can cause electrical shocks
- Ultraviolet (UV) rays or light and, to a lesser extent, infrared (IR) radiation that can cause skin burns and damage to eyes
- Noise that can damage hearing

Before the Work

Many companies require a **written permit** system for hot work. Permitting systems help ensure everyone takes appropriate precautions prior to hot work. Precautions for **hot work** include inspecting and preparing the work area, moving or protecting combustible and flammable materials, and assigning a dedicated fire watcher with an extinguisher.

To prepare the **work area**:

- Inspect and control the hot work area BEFORE you start the work
- Do NOT weld, cut or braze in the presence of combustible or flammable fluids or atmospheres (gases, vapors or dusts)
- Inspect cracks and holes in the floor, walls and ceiling of the work area

Check the work area for **combustible materials**. Remove all objects that could catch fire (such as oily rags) or explode (such as flammable liquids and spare gas cylinders). Move all combustible material at least 11 meters (35 feet) horizontally from where the hot work will take place. If you cannot move remaining combustibles, protect them with appropriate guards and covers. If you cannot move or protect combustibles, do NOT weld, cut or braze in the area.

Welders are responsible for ensuring that the environment around them is free of hazards to protect the safety of all employees and property in the immediate area. It is EVERYONE'S responsibility to stop work immediately if they notice unsafe conditions.

Employers must train all hot work personnel about how to use portable fire extinguishers. Be familiar with escape routes and know how to sound alarms in case of fire.

Inspect and wear **personal protective equipment (PPE)** as prescribed in the job hazard analysis or other risk assessment. PPE can supplement other controls that protect you from hazards like heat, ultraviolet (UV) and infrared (IR) rays or light, electricity and noise. PPE may include:

- Welding goggles or a welding helmet with a cap underneath
- Thermal insulated welding gloves
- Fire-resistant (FR) sleeves
- Fire-resistant or leather cape or shoulder covers (for overhead work)
- Electrically rated leather shoes with safety toes
- A respirator with appropriate medical and fit testing (for some operations)
- Earplugs or earmuffs (for noisy operations and to repel sparks)

Follow your employer's procedures for removing defective PPE from service and replacing it.

During the Work
Follow your employer's safety protocols when using compressed gas cylinders for gas welding and electricity for arc welding.

Check for **explosion hazards**. Do NOT perform hot work operations on anything containing flammable or toxic material. Grease, tar, acid or other materials may produce flammable or toxic vapors. Sealed containers may burst when they are heated. Opening a hatch, flange or lid is a simple way to prevent pressure buildup.

Check **empty containers**. Treat any empty containers as flammable or toxic. Follow the instructions on the Safety Data Sheet (SDS) to clean containers and ensure that no flammable or toxic materials are present. Verify that containers are free of residue on the bottom or in crevices.

Small amounts of flammable liquid in a drum or other container may be enough to cause an explosion when you apply heat.

Electric arc in welding generates ultraviolet (UV) rays or light, which can cause severe skin burns, damage to eyes and skin cancer. For protection against UV rays or light, wear welding helmets and protective clothing. High-intensity UV light also reacts with the air around the welding arc to produce ozone, nitrogen oxides and carbon monoxide.

Electric arc and flame-based cutting equipment generate infrared (IR) radiation, which may cause thermal burns. For protection against IR radiation, wear welding helmets or goggles and protective clothing.

Arc welding generates intense light that can damage your eyes when you see it or its reflection. Because much of the energy of welding cannot be seen and because the onset of burns can be gradual, we should NOT rely on perceived brightness or pain as indicators of what's safe when it comes to the UV rays or light and IR radiation associated with welding, cutting and brazing processes.

Wear appropriate welding helmets, safety glasses or goggles when you are welding. To protect people who will be around potentially damaging light, use welding curtains and post warning signs.

After the Work

Use your employer's fire watch procedures. A fire watcher should remain in the work area for at least 1 hour after finishing welding, cutting or brazing activities are finished to ensure that there are no smoldering fires.

Perform housekeeping to remove hazards created during the work.

If anyone is injured during welding, cutting and brazing activities, such as receiving burns or electrical shocks, IMMEDIATELY follow your employer's first aid and reporting procedures.

Welding, Cutting and Brazing Part 3: Health Hazards

Welding, cutting and brazing methods and materials can result in health hazards associated with welding gases and fumes. These hazards can cause immediate and long-term illnesses as well as damage to your ability to see and hear. You will receive training from your employer about the specific hazards and controls associated with your work.

Common Health Hazards
When you are welding, cutting and brazing, you may be exposed to health hazards when:

- You inhale toxic gases or fumes
- Grinding activities generate dust that you inhale
- You ingest chemicals or metals that are on your hands when you eat, drink, apply cosmetics or lip balm, or use tobacco

Exposure to ultraviolet (UV) rays or light and infrared (IR) radiation can burn your eyes and skin and may cause blindness or cancer. Exposure to noise can temporarily or permanently damage your hearing.

All welding processes involve or produce hazardous **gases** that are invisible and may be odorless. The heat and UV rays or light associated with gas torch and electrical arc welding produce gases such as carbon monoxide, carbon dioxide, nitrogen oxides and ozone. Other gases and vapors may be produced as by-products from the breakdown of solvents or coatings on the metal. Gases used for arc shielding or as a fuel are also emitted during welding, cutting and brazing.

Welding, cutting and brazing produces **fumes** when hot metal vapors cool and condense into small particles that stay suspended in the air. Fumes from welding include vapors from heated welding rods, wires, fluxes, filler metals, base metals, metal coatings such as zinc on galvanized steel, and cadmium plating. Welding smoke is an example of a visible fume, but some particles in fumes are so small that they may not be visible. Even if you can't see fumes, their particles are present.

Without proper controls, the method and materials involved in a welding, cutting and brazing task can expose people to the chemicals in fumes, like:

- Zinc
- Cadmium
- Beryllium
- Iron
- Mercury
- Lead
- Paint and coatings
- Fluorides
- Chlorinated hydrocarbon solvents
- Carbon monoxide
- Ozone
- Nitrogen oxides
- Hexavalent chromium

You will be trained about the specific chemicals to which you may be exposed. You may be able to test for some materials, such as lead, in paint and coatings so that you may take appropriate precautions to prevent exposures.

To determine the chemicals that you may be exposed to and what their health effects may be, use job hazard analyses, process and procedure documentation, Safety Data Sheets (SDSs) and training materials. If you do not have or understand the contents of these sources, contact your supervisor.

The **short-term health effects** of overexposure to welding fumes may include:

- Difficulty breathing
- Nausea, loss of appetite and weight loss
- Diarrhea or constipation
- Head, chest or stomach pain
- Eye, nose, throat and skin irritation
- Fatigue
- Weakness
- Tremors
- Changes in vision and hearing
- Flu-like symptoms (metal fume fever)

Long-term health effects of overexposure to welding fumes may include chronic breathing problems and lung conditions; damage to tissues and organs; damage to the circulatory, nervous and reproductive systems; cancer; or death.

Immediately get away from fumes if you begin to experience any symptoms of exposure. Follow first aid and emergency instructions in your employer's procedures and the SDS. Report symptoms to your employer so they may identify and correct exposure concerns and arrange for medical care, if necessary.

Controls for Health Hazards

To control people's exposure to health hazards associated with welding, cutting and brazing, we must use a combination of elimination, substitution, engineering controls, work practices and personal protective equipment (PPE).

Eliminate situations in which you may be exposed to chemicals. For example, remove paints or coatings from surfaces before welding, cutting or brazing them.

Substitute a hazardous chemical or process with one that is less dangerous. For example, use a different welding method, change base materials, use low-manganese filler metals or change your shielding gas.

Use **engineering controls** to capture or dilute the concentration of hazardous gases and fumes before they reach people. For example, use local exhaust and general ventilation to maintain acceptable air quality.

Use **work practices** to reduce your exposure to chemicals. For example, position your body to keep your head out of the weld plume, keep chlorinated solvent containers away from welding areas, and allow metals cleaned with chlorinated solvents to dry in a well-ventilated place away from the welding area.

Wear **PPE**, such as a respirator, to supplement other controls.

Hot Work for Construction

Hot work refers to any type of work that produces or uses a spark, flame or heat sufficient for combustion. Because of the potential for fire and injury presented by hot work, it requires certain special procedures that you need to know about.

Precautions

- Whenever possible, avoid hot work. Employ alternative methods
- When hot work must take place, move it away from any building (e.g., to a pre-fab area that's been designated for hot work activities)
- When the work cannot be moved, make the area safe for hot work Relocate movable combustibles within a 35-foot (11-meter) radius to a safe location
- Use safeguards to protect immoveable combustibles and nearby personnel from the heat, sparks, fumes and light
- Inspect designated areas before beginning hot work. These areas must be free of rags, cardboard, oils, grease, solvents and other combustibles
- Make sure sprinklers, fire hoses and extinguishers are available, appropriate and working
- Combustible materials within a 35-foot (11-meter) radius of the hot work should be either removed or shielded from potential heat, sparks or flame
    - Remove flammable liquids, paper, wood shavings, dust and oil deposits
    - Eliminate explosive atmospheres in the area
    - Seep floors clean of sawdust, scrap wood and other debris (kindling)
    - Wet down and cover combustible floors with damp sand or fire-resistant sheets
    - Remove all other combustibles whenever possible, or protect them with fire-resistant blankets or metal shields
    - Cover all wall and floor openings with fire-retardant or noncombustible material – this includes doorways, windows and even cracks in the floors and walls
    - Suspend fire-resistant blankets beneath the work area where there is a chance sparks, slag and other hot work pieces may fall to a lower level
    - Shield and/or shut down duct and conveyor systems that might carry sparks
    - Another approach is to "box in" the hot work area with screens so no ignition sources will escape the work area
- When work is to take place on walls, ceilings and/or enclosed equipment:
    - Move, shield and/or watch combustibles on the other sides of the walls
    - Purge containers of flammable liquids/vapors
- Use trained, equipped and authorized **fire watchers**
    - Fire watchers observe the hot work operations to anything/anyone doesn't catch fire
    - Fire watch must be in place during and for at least 60 minutes after hot work, including during any breaks
- After hot work is finished, the hot work area should be monitored for up to 3 hours

Responsibilities

ALL workers are expected to look for things that are unsafe, but some people have specific responsibilities relative to the hot work permitting process.

Company Management

Company management is responsible for:

- Designating personnel who will authorize permits and ensure hot work is conducted safely
- Making sure that workers involved in hot work (including subcontractors) is familiar with jobsite hot work requirements
- Informing subcontractors of site-specific flammable materials, hazardous processes or conditions, and other potential fire hazards

Permit Authorizers

Management designates permit authorizers who are responsible for:

- Knowing where flammable materials, hazardous processes or other potential fire hazards are likely to be present
- Moving work to a location that's free from combustibles
- If the work cannot be moved, moving the combustibles to a safe distance or having them properly shielded against ignition
- Coordinating activities to prevent work with solvents and other flammable materials near hot work operations
- Preventing hot work from taking place if conditions are not safe and stopping hot work if conditions become unsafe
- Making sure that fire extinguishing equipment is properly located at the site
- Ensuring that a fire watcher is ready and able to perform as needed

Hot Work Operators

Welders and other hot work operators are responsible for duties such as

- Getting permits approved before starting hot work
- Ensuring hot work equipment is in safe operating condition
- Stopping work and notifying others if unsafe conditions develop

Fire Watchers

Fire watchers will:

- Be in place during and for at least 60 minutes after hot work, including during any breaks
- Understand hazards
- Ensure that safe conditions are maintained during hot work
- Stop work if unsafe conditions develop
- Have fire extinguishing equipment and know how to use it
- Get help in the event of a fire

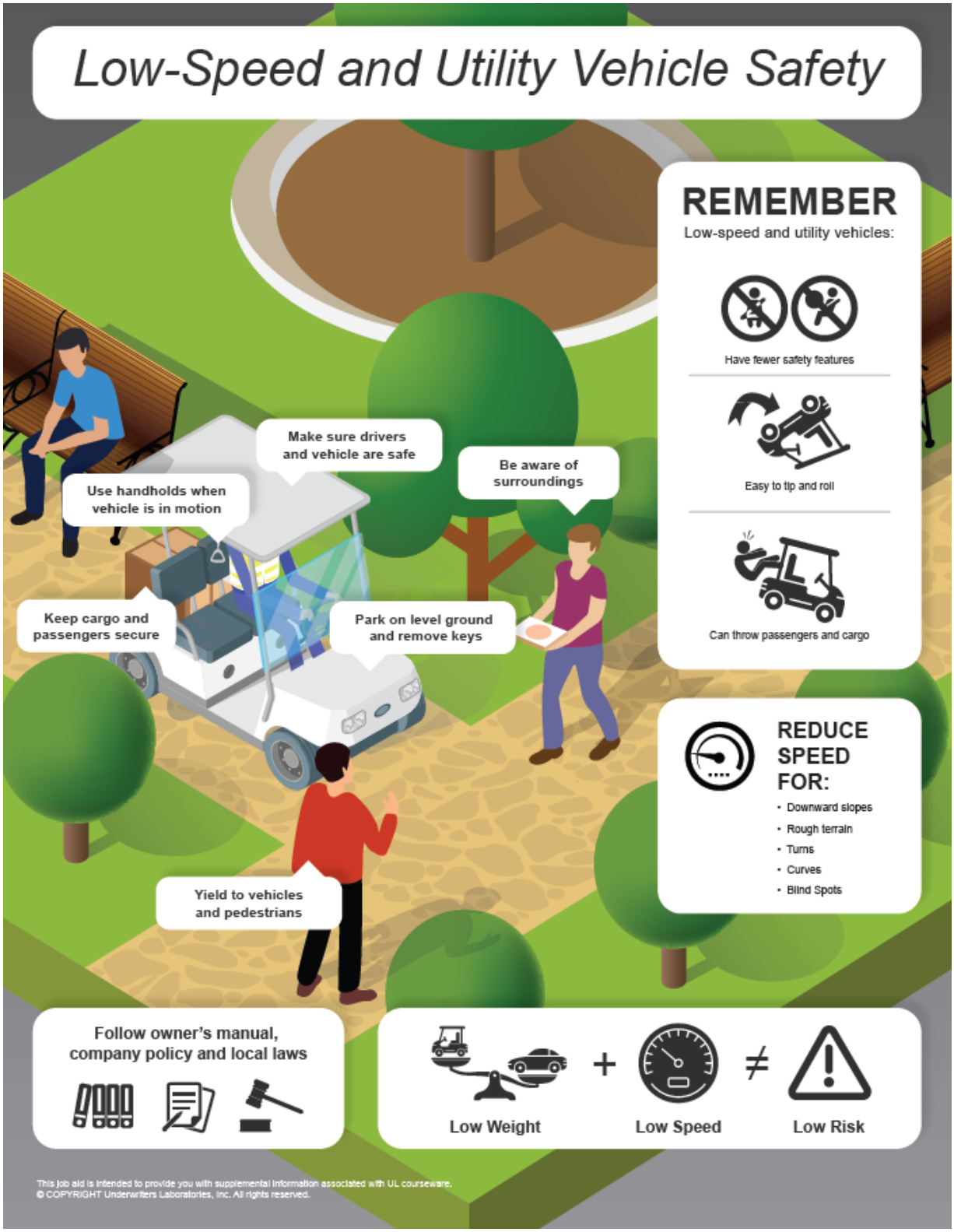
Typically, the watch takes place within 35 feet (11 meters) of the hot work but potentially further for falling sparks and materials carried by wind or draft. Multiple fire watchers are needed if a single fire watcher cannot see all areas where sparks and heated materials travel.

Fire watchers try to extinguish fires only when it is obvious that they can be put out with the available equipment. They will immediately get help if the fire cannot be handled with the available equipment

Hot Work Permits

When it is established that hot work must take place outside of a designated pre-fab area, a written permit has to be issued by a permit authorizer. No hot work can take place without a permit (unless done in an area specifically designated for hot work). Hot work permits are posted at the jobsite in an accessible and conspicuous location.

Low-Speed and Utility Vehicle Safety



Defensive Driving – Small Vehicles

Preparing to Drive Safely

Inspect the Vehicle

Before you move the vehicle:

- Check for obvious signs of damage
- Inspect the tires
- Clean the interior
- Adjust the driver's seat and steering wheel
- Check for appropriate documentation in the glove box
- Test brakes, wipers, headlights, turn signals and brake lights
- Remove mud, ice and snow off the vehicle and windshield

Adjust the Mirrors

A blind zone is an area you can't see due to configuration, vehicle obstructions or other visual limitations. Be aware of your blind zones and stay out of other drivers' blind zones.

To minimize blind zones:

- Adjust the **left** and **right mirrors** to point away from your vehicle
  - You should barely see the body of your own vehicle in the reflection
- Position your **rearview** mirror so that the view outside your back window is centered

Remove Distractions

Before your trip:

- Plan your route
- Allow adequate time
- Put away your mobile devices
- Finish food, drinks and cigarettes
- Set the vehicle controls

Assess Your Condition

Wear your seat belt. Don't drive if you:

- Are upset
- Have been drinking alcohol
- Have taken medicine/drugs that impair your judgment/reaction time or cause drowsiness
- Are drowsy

Best Practices for Driving Safely

To drive safely:

- Buckle up
- Pay attention to your speed and the speed limit
- Keep an eye on what's ahead of you
- Use the "3-second rule" for following the vehicle in front of you
  - Increase to 6 seconds or more in inclement weather and poor conditions
- Allow tailgaters to pass you (do NOT honk or slam or tap brakes)
- Begin slowing down as soon as you see an obstruction, stop sign or intersection
- Avoid backing whenever possible (use mirrors and spotters when you must back up)
- Stay away from aggressive/angry drivers

Intersections

At intersections:

- Slow down or stop for yellow lights

- Never assume you have the right-of-way
- Never attempt to pass other vehicles or change lanes
- Delay acceleration when it's your turn to go
- Use caution at train and commuter rail crossings

Changing Lanes

When you change lanes:

- Signal well in advance
- Be aware of blind zones – yours and others'
- Remember that traffic already in the lane has the right-of-way
- Only change one lane at a time
- Do not weave in and out of traffic
- Avoid passing on another driver's passenger side
- Never pass on the shoulder

Remain Calm

No matter what is happening, remain calm while you drive:

- Avoid aggressive driving and road rage
- Do not pressure other drivers to go faster or get out of the way
- Do not cut people off
- Avoid honking and gesturing at other drivers
- Drive safely, steadily and predictably